INDIANA DEPARTMENT OF TRANSPORTATION
Driving Indiana's Economic Growth

Indiana Government Center North
Room N601
Indianapolis, Indiana 46204

PHONE: (317) 234-0410
FAX:

Eric Holcomb, Governor
Joe McGuinness, Commissioner

May 22, 2020

Mayela Sosa
United States Department of Transportation
Federal Highway Administration - Indiana Division, Division Administrator
575 North Pennsylvania Street, Room 254
Indianapolis, Indiana 46204

RE: Request for directional closures (concurrent or non-concurrent) of I-64 from Exit 123 (New Albany, Indiana) to Exit 1 (I-264) in Louisville, Kentucky. (INDOT contract B-40719)

Pursuant to Section §658.1 l(d) of the Code of Federal Regulations, the Indiana Department of Transportation (INDOT), in cooperation with the Kentucky Transportation Cabinet (KYTC) and under the guidance of both Indiana and Kentucky Division offices of FHWA, hereby requests approval of its plan for concurrent or non-concurrent directional closures of the I-64 Sherman Minton Bridge (SMB) across the Ohio River on the northwest side of Louisville in Jefferson County, Kentucky. I-64 eastbound and I-64 westbound could be closed concurrently or each will each be closed separately between Exit 123 (New Albany, IN) and Exit 1 (I-264) for the following durations:

- One (1) nine (9) consecutive day closure per direction per calendar year (concurrent or non-concurrent) AND
- Up to three (3) weekend closures per direction per calendar year (concurrent or non-concurrent).

Refer to **Attachment A** for a map of the proposed closures that are expected to occur during the 2021-2023 construction seasons.

Project Description

The work under this project involves rehabilitation of the I-64 SMB and the associated Indiana and Kentucky approach structures with the goal of extending the service life, identified as the Sherman Minton Renewal Project (SMRP). Rehabilitation work within the project includes bridge deck replacement, floor frame rehabilitation, cable hanger replacement, and bridge painting.

The SMB is one of three interstate crossings of the Ohio River in the Louisville metro area with three one-way lanes on both the westbound top deck and the eastbound bottom deck. The regional traffic counts collected for local Ohio River crossings as part of the Louisville – Southern Indiana Ohio River Bridges Project Post-Construction Traffic Monitoring Study show the SMB carries approximately 90,000 vehicles per day (Year 2018) on I-64 over the Ohio River between New

Albany, Indiana and the area of West Louisville in Kentucky. The SMB is currently the sole non-tolled interstate bridge serving the area.

The confined construction area on the bridge provides a significant challenge to find construction techniques and maintenance of traffic schemes that can safely, efficiently and economically construct this work, while maintaining acceptable traffic operations for the many motorists using this corridor. A comprehensive set of MOT alternatives were considered and analyzed as part of this project. The alternatives were evaluated with consideration of traffic impacts to the highway and local street networks, construction duration, economic impact to drivers, and safety risks. A report summarizing the MOT options analysis is provided as **Attachment B**. Additionally, the project team has engaged the public through a series of community advisory council and environmental justice task force meetings in both Indiana and Kentucky throughout the project. The resounding theme from these meetings were to maintain existing cross river connectivity and minimize or not allow full closure of the bridge. The public understood this would result in a longer construction duration but are willing to accept the longer duration.

A hybrid alternative was developed that closes one lane in each direction and maintains two westbound and two eastbound traffic lanes through a four-phase schedule. This alternative has been defined as the baseline MOT option and is presented in **Attachment C**. The recommendation provides for maintaining two lanes in each direction throughout the project with an allowance for the closure of one additional lane in each direction during overnight hours. Nighttime lane restrictions allow for material delivery and removal. The lane closures related to the baseline MOT option will be determined following an approved Indiana Highway Congestion Policy (IHCP) exception that utilizes queuing analysis to determine allowable hours for lane reduction.

In addition to the baseline MOT reduction of lanes, separate or concurrent nine-day consecutive closures, and up to three separate or concurrent weekend closures (per year) are being requested in order to facilitate essential construction activities to provide safety and expedite schedule. Additional explanation for the need for these closures is provided later in this letter under the Maintenance of Traffic Alternatives Considered.

Project Procurement Method

This Project is being procured through a Design-Build Best Value (DBBV) procurement process. The Indiana Finance Authority (IFA), in coordination with INDOT, is leading this procurement process. Throughout this request letter, whenever INDOT is referenced relative to the procurement process, it should be assumed that it is acting in conjunction with and/or support of the IFA. The Project has now entered the Request for Proposal (RFP) stage. INDOT has prepared the Draft Public, Private Agreement (PPA), Technical Provisions (TP) and preliminary plans. Maintenance of Traffic (MOT) requirements regarding closures will be incorporated into the Technical Provisions and provided to the DB teams for this Project. At the end of the RFP stage, each DB team will submit their formal proposal which will include their proposed price, schedule, MOT plan, and project approach based on the scope of work identified on the preliminary plans and the

requirements defined in the TP's. The awarded team will be subject to liquidated damage penalties if they fail to reopen the closed interstate within the duration committed to in their bid proposal.

Maintenance of Traffic Considerations

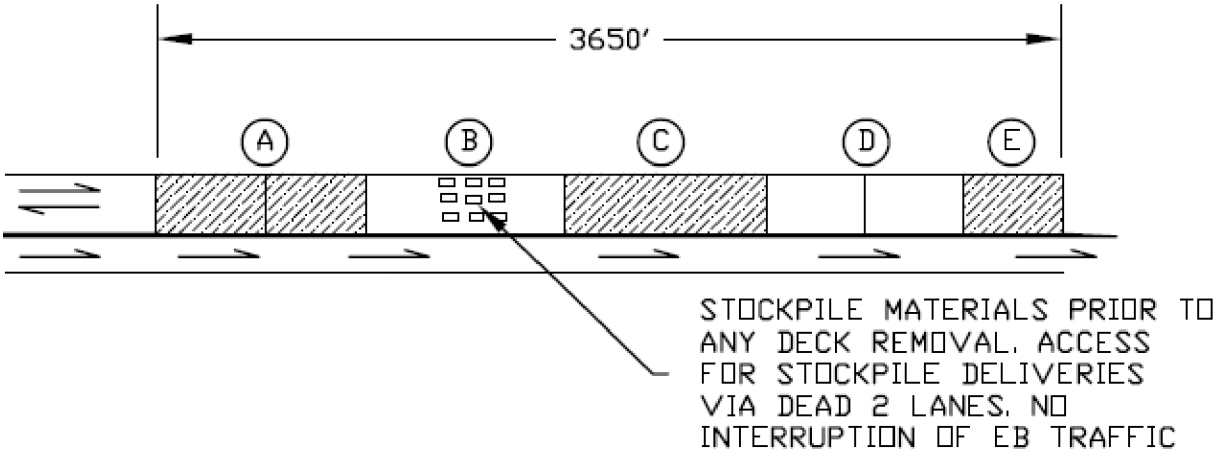
INDOT will select a Design-Build Contractor (DBC) to finish the design and construct the Project based on the best value determination considering price, schedule and technical approach to the Project. The DBC will prepare their own maintenance of traffic plans, phasing, and schedule that will be compliant with the PPA and TP's. INDOT's goal is to have this Project completed and open to traffic by mid-2023. This is an aggressive construction schedule considering the size and complexity of the Project. It is anticipated that the winning team will be under contract in the spring of 2021.

The DBC will identify when the I-64 directional closures will occur, while INDOT identifies the parameters the DBC must work within. The three (3) weekend closures will begin on a Friday evening (9 p.m.), and end by the following Monday morning (6 a.m.). The nine (9) day directional closures will be nine consecutive days and can start on any day of the week. The RFP documents (PPA and TP's) provide windows of closure times during the 2021-2023 construction seasons. INDOT will ensure no lane restrictions will occur on interstate detour routes during the I-64 closure periods.

The items in the Project scope anticipated to be completed under the directional 9-day closures include (but are not limited to):

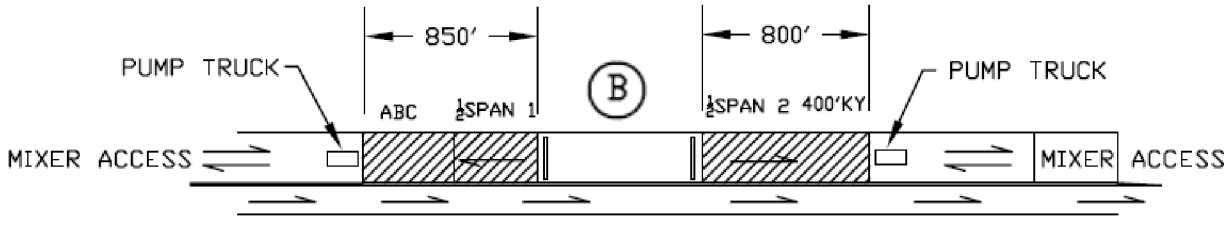
- Installation of expansion joints
- Portions of concrete bridge deck replacement activities
- Replacement or rehabilitation of structural members normally under traffic loads
- Installation of lower deck protection / upper deck containment system
- any other items that cannot be efficiently completed with phased traffic

The DBC will need to account for structural stability, dead load deflections and steel configurations during construction activities such as removal and replacement of the bridge deck. Due to access and equipment limitations, it is likely that the work areas will need to be separated along the length of the structure and two areas adjacent to each other cannot be worked on at the same time. The following figure portrays this approach.



This approach would apply to both decks. The following description is for the lower deck where one EB lane is being maintained. Two of the critical path operations that would benefit from a full closure are the deck pouring operation and concrete curing period. The deck pouring operation is very demanding due to the distance the concrete is needed to be pumped. In addition, the deck cure period, in which live traffic is not allowed on the recently poured deck, is critical as it does not allow the resupply of materials to other segments without additional lane closures and removal of temporary concrete barrier for access. Both critical path operations could be minimized/partly eliminated by allowing the closure of EB lane for a longer period of continuous time rather than just a nighttime closure.

Regarding the deck pouring operation, pumping concrete 850'+ from one end is possible under ideal conditions. The set up time for these pours would be significant including numerous shifts on the critical path and would require favorable weather and other restraints that are sometimes not predictable. Assuming a complete closure, the barrier could be opened in area "B" which would allow pumping from both ends. This option is not viable if the closure period is limited to only a nighttime duration. The following figure shows pumping from one end and the open area "B" could be opened to a second pump trucks during a full closure.



Another critical path operation that could take advantage of a full closure would be the installation of the upper deck containment system. The upper deck containment will generally be installed from "the lower deck". Providing full width access to the DBC for this installation will be an advantage/time savings.

It is estimated that 15 working days per deck could be saved using the 9-day closures (once per deck level) and assuming the overall work would proceed as assumed and outlined above. This could eliminate an estimated 30 workings days from the total project duration saving both time and user costs for the project. These 30 working days (42 calendar days) equates to approximately 5% of costs savings to the users of this facility during this project.

Refer to **Attachment D** for typical roadway sections showing the structure location and the complexity of installing a new deck on the bridge. Completing the work with I-64 closed to traffic will reduce queue exposure and create a work site that is protected from traffic. It is estimated that this work will take up to 9 days for each direction of travel to complete, with the breakdown of construction operations summarized below:

Operation	**Duration**
Remove MOT for access, prepare for concrete deck pour	1 day
Install deck replacement, repair expansion joints, replace critical structural members	6 days
Remove debris, reset MOT phase, restock materials for next installation areas	2 days
TOTAL	9 days

The items in the Project scope anticipated to be completed using up to three directional weekend closures per direction per calendar year include (but are not limited to):

- Installation of 20,000 linear feet of temporary concrete barrier wall, both non-anchored and anchored.
- Deck removal
- Installation of specialized equipment, such as a gantry crane
- Hanger cable replacements
- any other items that cannot be efficiently completed with phased traffic

For the baseline MOT option, it is anticipated to require approximately 20,000 linear feet of temporary concrete barrier, both non-anchored and anchored. To install this under live traffic is always a safety concern. The DBC could have two crews setting barrier, one on the top deck and one on the bottom., It is anticipated all the barrier can be installed under one weekend closure.

Weekend closures could also be used for a critical path operation, deck removal. Even though not all of one deck can be removed in one weekend closure, using the work areas described previously, deck removal could be completed in multiple work areas at a time.

One goal of this DBBV contract is to allow the DBC an avenue to develop some innovative concepts that can take the advantage of full closures and expedite the schedule in a safe manner. One way of accomplishing this is the use of specialized equipment. An example on this project may be the use of a gantry crane, especially on this type of bridge where there is limited overhead space for conventional cranes.

Providing the DBC with up to three weekend closures allows for flexibility, since there is a restriction on how much work can be done while maintaining two lanes of traffic in each direction on the bridge (except nighttime work). This flexibility allows the DBC to complete any of these different work types, or combination of such, during any of these weekend closures. It is expected that a short-term weekend closure will allow the DBC to complete work concurrently that otherwise would require an inefficient phased traffic plan that increases the amount of queueing on I-64. In addition, these closures provide safe work zones for both the construction workers and the travelling public. This approach is considered aggressive; however, the approach considers minimizing closure impacts to adjacent communities and for the traveling public.

The impact to mobility under a full closure of I-64 (both directions) and non-concurrent directional closures were evaluated using a project-specific travel demand model (SMRP TDM) that was developed based on the Kentuckiana Regional Planning and Development Agency (KIPDA) regional travel demand model. See **Attachment E** for model output from analyzing all three scenarios. Although most diverted trips will be detoured along the interstate system, both concurrent and non-concurrent directional closures will result in some trips diverting to the local street network.

Looking at recent precedents, the I-64 Sherman Minton Bridge was abruptly closed in 2011 for a period of four months to allow for emergency structural repairs. Initially, the diversion of traffic to other bridges caused major congestion and delay on alternate routes. But a system of emergency mitigation strategies, including capacity addition to key system ramps, was developed and implemented to help alleviate traffic impacts during that time. These strategies, coupled with drivers' willingness to adjust their travel patterns, were able to reduce queueing and congestion within two weeks of implementation. Additionally, counts for total daily cross-river trips on all bridges before and during the emergency closure showed that cross-river trips decreased by almost 50,000 during the closure. The results of the SMRP TDM referenced above assumed that the current number of total daily cross-river trips is fixed. As observed during the 2011 closure, it is likely that there will be at least some reduction in total cross-river trips if the Sherman Minton Bridge is closed. Therefore, the traffic diversion shown in the SMRP model's output is a worst-case scenario.

Prior to the 2011 emergency closure, there were 17 total lanes crossing the river including the Sherman Minton (I-64), Clark Memorial (US 31), and Kennedy (I-65 NB & SB) bridges. During the emergency closure of the Sherman Minton bridge, only 11 lanes were available for crossing the river. Since that time the Lincoln (I-65 NB) and Lewis & Clark (East End I-265) bridges have been constructed bringing the total number of lanes across the river to 26. That means during a full closure of the Sherman Minton Bridge, there would be nine more lanes available across the river than there were during the emergency closure of 2011. There are other major capacity improvements to the Kennedy Interchange in Louisville and the I-65 corridor in Indiana that have been added since the emergency closure. The I-65 and East End bridges are both tolled, and this has been considered by the SMRP TDM analysis.

Because of factors listed below, the proposed short-term closures of the Sherman Minton Bridge are not anticipated to be as impactful as those experienced during the emergency closure of 2011. During the proposed directional closures, the programmed ramp mitigations as detailed below are expected to limit congestion along interstate detour routes and encourage minimal usage of local, non-interstate route diversions. Traffic conditions will be monitored by INDOT and KYTC, and mitigation measures will be adapted as necessary.

- mitigation lessons learned
- a reduction in cross-river trips
- the additional bridge and interstate capacity added to the network since 2011
- much shorter duration of closure
- the ability to give the public plenty of advanced warning about the closure

Coordination will occur with other state and local projects throughout the KIPDA region. The most significant project beyond the SMRP includes the construction on I-265 between I-64 and I-71 on the east side of Louisville. The MOT plan for that project is not fully developed but will be coordinated with this project. Although it is our understanding the I-265 project would not require lane closures, the anticipated short durations of directional closures on I-64 over the three-year duration will be coordinated by project teams assigned to each project.

The identification of potential bottleneck locations on the highway network due to diverted traffic during a full closure identified potential areas for mitigation. Mitigating these segments by increasing the capacity of the segment by adding one additional travel lane has been implemented into the project. Four of the ramps that connect I-265 to I-64 and I-65 are predicted in some options to exceed the 1,900 vehicle per hour threshold. Each of the ramps are currently one lane. The I-265 WB to I-64 WB is already over the threshold under existing conditions. The project will provide two lane ramps in the temporary condition for the entire duration of the project for the following ramps: I-64 EB to I-265 EB, I-265 WB to I-64 WB, and I-265 EB to I-65 SB. Because of the loop configuration of the I-65 NB to I-265 WB ramp and the affect to other ramps due to adding a second lane, the project will not provide two lanes on this ramp. Under the mitigated conditions, the three ramps would be under the 1,900 vehicles per lane indicating operations better than LOS E. All but the NB I-65 to WB I-265 ramp had a second lane added during the 2011 emergency closure.

The justification for this overall interstate closure request is based on the provision found under Title 23 of the Code of Federal Regulations Section §658.11 (additions, deletions, exceptions, and restrictions) with subcategories d.2.i, ii, iii, and iv.

§658.11 d.2.i Analysis of Safety Problems

INDOT believes the best way to ensure the safety of the construction workers and the motoring public is to eliminate all vehicular traffic across this stretch of I-64 for the scope of work items stated above. Closing I-64 annually for up to 9 days and permitted weekends will reduce lengthy traffic queues and delays that would be caused by further reducing the number of travel lanes available. Reducing the queues and delays will reduce exposure to high speed rear end, typically severe, crashes at the back of queues. Closure of the interstate will provide a safer working environment for the construction workers on the interstate. INDOT will be working with the selected DBC to determine the best mitigation opportunities to address traffic management issues. Strategies to be evaluated include use of state police, Hoosier Helpers, and various queue mitigation strategies. These items may be deployed within the project limits or on other roadways impacted by the closures. As a full bridge closure is very similar to what unexpectedly occurred in 2011, along with the more recent increase in cross-river capacities we believe the above pre-planned strategies would be even more beneficial than what was utilized in 2011. All mitigation strategies will be evaluated further as the selected DBC and the project team work to develop and refine the TMP and MOT plans.

§658.11 d.2.ii Analysis of Impact on Interstate Commerce

The temporary directional closure of I-64 is anticipated to have negligible impact to Interstate commerce. Through traffic on I-64 will be detoured by using I-65 and I-265 as shown in **Attachment A**. INDOT plans to sign and maintain the optional detour routes for the duration of the project when the bridge is not fully closed and through the duration of the 9-day directional closures. The INDOT Traffic Management Center (TMC) will monitor traffic along I-64 and I-265 in Indiana while Traffic Response and Incident Management Assisting the River City (TRIMARC) will monitor I-64 and I-264 in Kentucky. Using the existing ITS facilities, these departments will be able to react and implement mitigation strategies during these closures. We have found on other closure projects in Indiana over the past two construction seasons that weekend closures can be adequately handled by changeable message signs, dynamic message signs and an aggressive communication plan. By not having to uncover and cover the many overhead panel signs for a shorter weekend closure provides an adequate and safer situation relative to the alternative of having to modify overhead panel signs. For local traffic, route marker assemblies and portable changeable message signs will be utilized at numerous locations to direct traffic to downtown Louisville and back to I-64. Permanent dynamic message signs in the Louisville metro area will also be utilized to inform and direct motorists.

INDOT believes the I-65 and I-265 detour routes will have negligible impact on interstate commerce as it will add minimal time and distance to an interstate or long-distance trip. These detour routes are calculated to only take less than 4 minutes of additional travel to complete. Additionally, given the value-of-time for interstate commerce, toll cost associated with either the I-65 or I-265 river bridge crossings should have little impact. INDOT will also approve an exception to its Interstate Highway Congestion Policy for this project.

§658.11 d.2.iii Analysis of Recommendations of Alternative Routes for Commercial Motor Vehicles

Commercial motor vehicles will use the I-65 and I-265 detour as mentioned above. These detour routes will have no lane restrictions during the closure periods. INDOT will coordinate the assignments of the available Hoosier Helper workforce along the detour routes and to help address incident response and minimize any incident impacts. INDOT will also post the closures in the Condition Acquisition and Reporting System (CARS 511) which is part of the INDOT traveler information website "TrafficWise". With respect to oversize and overweight permit requests, INDOT will work with the Indiana Department of Revenue to ensure permits will direct permitted vehicles along an acceptable alternate route. If a permit load is dependent on the closed route, then notice can be given to the carrier of the anticipated closure duration so that they can schedule their transport accordingly. With the two separate directional closures (concurrent and/or non-concurrent) and with the defined closure periods, permitted vehicles would be able to adjust their schedule a minimal amount of days or utilize the defined alternate route. INDOT will also notify the Indiana Motor Truck Association of the project plan so that they can communicate with their members. INDOT also works very closely with the Indiana State Police to provide current information relative to the closure periods.

§658.11 d.2.iv Evidence of Consultation with Local Governments Directly Affected

Coordination has been on-going with the Cities of New Albany, Indiana and Louisville, Kentucky as well as the Kentucky Transportation Cabinet (KYTC). INDOT may also consider the adjustment of traffic signal timing at key intersections that may see significant short term increases in traffic. A project specific Travel Demand Model (TDM) was developed based on information provided by the Kentuckiana Regional Planning and Development Agency (KIPDA). The TDM was used to conduct traffic diversion modeling. The output from the TDM to anticipate changes in traffic patterns was utilized to determine our recommended alternative. INDOT will utilize extensive public outreach methods to reach stakeholders that will be affected by this project, like the efforts conducted for previous interstate closures. INDOT plans to continue to use a variety of traditional and social media outlets to disseminate information regarding the project. The DBC will work closely with our Public Information campaigns to provide regular updates of different phases of the project. Specifically, during the times of the 9 day and weekend closures, there will be ample time for advance notice of upcoming closures. For the 9-day closure, the DBC will be required to provide a minimum 28-day advance notice of the proposed closure. For the weekend closures, the DBC will be required to provide a minimum 14-day advance notice.

In summary, INDOT has carefully evaluated alternatives to the proposed project and has concluded that directional closures of I-64 provide the best alternative to ensure the safety of the motoring public and the construction workers with the least amount of impact to interstate commerce. INDOT respectfully requests the Federal Highway Administration grant approval of this request for these temporary, directional closures of I-64. INDOT will continue to work with the Federal Highway Administration Indiana Division Office on the details of this project. If you have any questions regarding this request, please feel free to contact the Senior Director of Engineering & Research, Jim Poturalski, at 317-234-0410 or via email at jpoturalski@indot.in.gov

Respectfully submitted,

James Poturalski Digitally signed by James Poturalski Date: 2020.05.21 14:17:01 -04'00' for

Roland Fegan, PE
Deputy Commissioner of Construction

FHWA Indiana Division Approval: Subject to NEPA Approval.

Digitally signed by JAY D DUMONTELLE
Date: 2020.06.10 16:09:10 -04'00'

Project Delivery Team Leader

Title for Mayela Sosa, FHWA Indiana Division Administrator
Date June 10, 2020

Attachments:

A. I-64 closure limits and detour plans
B. MOT Options Analysis Report
C. Baseline MOT Option
D. Roadway plans showing construction limitations (closure required)
E. TDM Diversion Maps

Cc: Ronald Heustis, INDOT Project Manager
Eryn Fletcher, FHWA Indiana Division
Karen Stippich, FHWA Indiana Division
Andy Detrick, INDOT Major Projects
Damon Brown, Seymour District Traffic Engineer
Gary Kreutzjans, Seymour District Construction Director
Jim Sturdevant, Traffic Management Director
Jim Poturalski, Senior Director of Engineering and Research

ATTACHMENT 13-1

Reinforced Soil Slopes

Description

This Work shall consist of preparing the design, furnishing the materials, and constructing the reinforced soil slope, RSS, to the lines, grades and dimensions shown in the Design Documents, this special provision, any additional requirements specified by the RSS system supplier in the approved shop drawings and as directed by IFA.

General Requirements

The RSS system shall consist of reinforced fill, soil reinforcement, a facing treatment, and incidental materials designed to provide adequate stability of slopes with inclines of up to 70 degrees which are resistant to erosion and requiring little or no long-term maintenance. Tiered vegetated facing treatment shall be used, unless otherwise specified in the Design Documents.

Reference Standards

American Society for Testing and Materials (ASTM)

1. ASTM D 422 Particle-Size Analysis of Soils
2. ASTM D 698 Laboratory Compaction Characteristics of Soil –Standard Effort
3. ASTM D 1238 Melt Flow (HDPE and PP)
4. ASTM D 1248 Molding and Extrusion (HDPE)
5. ASTM D 1505 Specific Gravity (HDPE)
6. ASTM D 2455 Carboxyl End Group (PET)
7. ASTM D 4218 Carbon Black Content (HDPE)
8. ASTM D 4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
9. ASTM D 4355 Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
10. ASTM D 4595 Tensile Properties of Geotextiles – Wide-Width Strip
11. ASTM D 4603 Intrinsic Viscosity (PET)
12. ASTM D 4884 Strength of Sewn or Bonded Seams of Geotextiles
13. ASTM D 5262 Unconfined Tension Creep Behavior of Geosynthetics
14. ASTM D 5321 Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
15. ASTM D 6637 Tensile Properties of Geogrids by Single or Multi-Rib Tensile Method
16. ASTM D 6706 Geosynthetic Pullout Resistance in Soil
17. ASTM D 7737 Individual Geogrid Junction Strength

Geosynthetic Research Institute (GRI)

1. GRI:GG4(a) Long-Term Design Strength of Stiff Geogrid
2. GRI:GG4(b) Long-Term Design Strength of Flexible Geogrid

American Association of State Highway and Transportation Officials (AASHTO) and Federal Highway Administration (FHWA) Documents

1. AASHTO LRFD Bridge Design, 8th Edition, 2017.
2. AASHTO LRFD Bridge Construction Specifications, 4th Edition, 2017
3. FHWA/NHI-10-024 and 025, GEC 11 Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Volumes 1 and 2

Design Requirements

The design shall be completed in accordance with the reference standards utilizing AASHTO load, resistance, and stability design criteria. The bottom of the RSS shall be established no less than 3 ft below the finished grade at the face of the RSS. No less than a 4-ft wide horizontal bench shall be provided in front of an RSS founded on slopes. Design submittals not in accordance with these reference standards and design criteria or technical/administrative criteria specified will be rejected in their entirety until compliance is achieved.

The RSS supplier shall be responsible for all internal and external stability aspects of the slope at all stages of construction. The design shall provide the required factors of safety/resistance factors using the soil reinforcement long-term nominal tensile strength (T_{al}) and pullout resistance for the reinforced fill proposed.

The soil reinforcement coefficient of interaction and mechanical interlock with the proposed reinforced fill material shall be selected and documented with appropriate test data. The soil reinforcement shall be dimensionally stable and able to retain its geometry under construction stresses and have high resistance to damage during installation considering ultraviolet degradation and all forms of chemical and biological degradation encountered in the reinforced fill. Soil reinforcement coverage ratios must be maintained at no less than 50 percent, and the maximum vertical spacing between primary reinforcement layers is 1.5 feet.

The appropriate test data documenting the connection design capacity with minimal elongation will be required as part of the submittal package for approval. Lap splices in the primary direction of the soil reinforcement will not be allowed.

The design computations shall indicate the factor of safety for the temporary construction and permanent slopes, considering both internal stability and external stability.

External loads, such as those applied through structure foundations, light and sign foundations, from traffic or railroads, and slope surcharge, shall be accounted for in the stability design. The presence of all appurtenances behind, in front of, or passing through the reinforced fill such as drainage structures, utilities, structure foundation elements or other items shall be accounted for in the stability design. The design shall address hydrostatic and erosive forces. Minimum live loads of 250 psf shall be used.

Design-Build Contractor shall avoid placement of utilities within the reinforced fill. Where placement of utilities within reinforced fill is unavoidable, Design-Build Contractor shall provide for access to the utility such that the integrity of the RSS is maintained in the event access to the utility is required in the future.

The design of the soil reinforcement shall account for the strength reduction due to long-term creep, chemical and biological degradation, stage construction issues, and installation damage and shall insure stress levels are below the allowable at the end of a 75-year design life. All components of the RSS, including elements used to form the facing treatment, shall be designed for a 75-yr design life.

Submittals

A minimum of 45 days prior to the Stage 3 Review Submission for the RSS, the Design-Build Contractor shall submit complete design calculations and shop drawings to IFA for review and approval. All submittals shall be sealed by a Registered Professional Engineer and shall contain all details, dimensions, quantities and cross sections necessary to construct the RSS and in accordance with Section 105 of Standard Specifications and, as a minimum, include the following:

1. Plan, Elevation and Cross section sheet(s) as shown in the Design Documents:
   i) Plan view showing the horizontal alignment and offset from the CL of the roadway to the toe and top of the RSS. Beginning and end stations for the RSS system and transition areas shall be shown. These views shall be developed from the plan view begin and end stations of the RSS System.
   ii) Elevation view indicating stations and elevations at the top and bottom of the RSS system. The stations and elevations of the final ground line along the length of the wall shall also be indicated. These views shall be developed from the elevation view top and bottom lines of the RSS system.
   iii) Location, length, size, coverage ratio, and type of soil reinforcement shall be shown. The stations or elevations where changes in soil reinforcement occur shall be clearly indicated.
   iv) Typical cross section(s) showing the elements and limits of the RSS system. These views shall include the reinforced fill, soil reinforcement, facing treatment, and their relationship to the right- of-way limits, excavation cut slopes, retained embankment, existing ground conditions and the finished grade line.
   v) Facing treatment details indicating type, elements and all dimensions necessary to construct the facing system. The details shall include facing interaction with the soil reinforcement and reinforced fill. The specifications for installation and establishment of vegetated facings shall be provided and shall be in accordance with the details on the plans. The selected facing shall provide a stable and erosion and sloughing resistant surface layer that will permit compaction against and near the face of the slope.
   vi) Locations of signs, lighting, guardrail posts, future locations of piles, and other infrastructure within the reinforced fill shall be indicated. Details for placing soil reinforcement around such elements shall also be provided.
   vii) Any general notes required for construction.
2. Design Computations: The shop drawings shall be supported by detailed computations for each design section indicating the design criteria specified have been met.
3. Manufacturer's Certification: The Design-Build Contractor shall include manufacturer's certifications and test results indicating that the proposed soil reinforcement, reinforced fill and facing treatment are in accordance with the design parameters used and the materials portion of this specification. IFA reserves the right to obtain random samples of materials for testing by IFA to confirm the certification values. No Work or ordering of materials for the structure shall commence until the submittal has been approved by IFA.
4. Design-Build Contractor's certification:
   i) The specific RSS system proposed for use on this project shall have been successfully used on a minimum of five similar projects and been successfully installed on a minimum of 1,000,000 square feet of

elevation view.

ii) The Design-Build Contractor shall have a minimum of 20,000 square feet of experience with the proposed RSS system. Contact names and telephone numbers shall be listed for projects used to document the
20,000 square feet.

Delivery, Storage and Handling

The Design-Build Contractor shall check all materials upon delivery to ensure that the proper type, grade, color and material certification have been received. The Design-Build Contractor shall protect materials from damage due to jobsite conditions and in accordance with the manufacturer's recommendations. Damaged materials shall not be incorporated into the Work.

Materials

Definitions

1. Soil Reinforcement – geosynthetic formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function as ground reinforcement.
2. Reinforced Fill – compacted fill that is within the reinforced soil volume as shown on the plans.
3. Foundation Soil – soil beneath entire RSS.
4. Retained Soil – soil behind reinforced fill of the RSS.
5. Facing Treatment – the elements used at the face of the slope to provide a stable condition and to promote a vegetated condition with little to no maintenance required.

Soil Reinforcement

Geosynthetic Reinforcement – shall be evaluated in accordance with FHWA GEC 011 with the following additions and clarifications.

1. The minimum RF_{ID} shall be ≥ 1.05.
2. The minimum RF_{D} shall be ≥ 1.10.
3. The minimum FS_{UNC} shall be ≥ 1.5.
4. Geogrids providing a minimum junction strength of 40 lbs per foot in accordance with GRI: GG2 and all geotextiles shall have a minimum mass of 8 oz/sy and meet the strength requirements of AASHTO M-288 Class 1 geotextile.
5. Geogrids not providing a minimum stiffness (flexural rigidity) of 30,000 mg-cm in accordance with ASTM D1388 and all geotextiles shall be staked during placement in accordance with Section 3.1.B.
6. PET geosynthetics shall be coated with a suitable coating immutably bonded to the PET bundles. The coating shall contain a minimum of 1% carbon black measured in accordance with ASTM 4218. Geogrids not meeting this requirement and all geotextiles shall use a minimum $RF_{D} = 1.6$.
7. PET geosynthetics shall possess a Molecular Weight $\geq$ 25,000 g/m in accordance with GRI: GG8 and a carboxyl end group number $\leq$ 30 in accordance with GRI: GG7. PET geosynthetics not meeting these criteria shall use a minimum $RF_{D} = 2.0$.
8. HDPE geogrids shall have a melt flow index value$\geq$ 0.88. HDPE geogrids not meeting these criteria shall use a minimum $RF_{D} = 2.0$.
9. Manufacturing Quality Control – The geosynthetic manufacturer shall have a quality control program that includes QC testing no less frequently than each 400,000 square feet of production. The testing, as a minimum, shall include Tensile Strength in accordance with ASTM D4595.

Reinforced Fill

Reinforced fill shall consist of soil meeting the Requirements presented in Table 3-1 of GEC 011.

Facing Treatment

The facing treatment shall be vegetated unless otherwise specified in the Design Documents.

The vegetated facing treatment materials shall include any top soil, compost, seeding, sod, erosion controls, watering provisions, or other vegetative systems complying with Section 621 of the Standard Specifications. RSS shall be constructed such that the vegetated portion of the slope is completed prior to the latest seeding dates shown in Section 621.12 of the Standard Specifications.

The tiered facing shall be established using cellular confinement or permanent welded wire forms.

Construction Requirements

General

The Design-Build Contractor shall obtain technical assistance from the supplier during slope erection to demonstrate proper construction procedures and shall include any costs related to this technical assistance in this item.

The foundation soils supporting the RSS shall be graded for a width equal to the length of the lowest soil reinforcement length. Cut slope surfaces shall be benched to allow the RSS to be keyed into existing retained embankment. Prior to soil reinforcement placement, the foundation soils shall be compacted.

Foundation soils found to be unsuitable shall be removed and replaced as directed by the Design-Build Contractor's geotechnical engineer. Water shall be diverted from the area where soil reinforcement is being placed and soil is being compacted.

At each soil reinforcement level, the reinforced fill shall be roughly leveled and compacted before placing the soil reinforcement. Reinforcement placement shall be installed in accordance with the manufacturer's recommendations and as shown on the approved shop drawings.

Place only that amount of reinforcement required for immediately pending Work to prevent undue damage. After a layer of soil reinforcement has been placed, the next succeeding layer of reinforced fill shall be placed and compacted. After the required facing treatment is installed and a series of reinforced fill lifts are placed to the next level of soil reinforcement, the next soil reinforcement layer shall be installed, and the process shall be repeated until the RSS height is completed. Soil reinforcement layers shall be laid flat, pulled tight prior to backfilling, and held in place with pins or other methods. Each soil reinforcement layer shall be placed to within 3 inches vertically of that shown on the shop drawings.

Where future foundations, such as light and sign foundations, are planned to be installed through the reinforced soil fill, temporary casing or otheR

means of providing future construction access shall be provided. Excavation, including drilling, through the reinforced fill is not permitted.

Reinforced fill shall be placed and compacted in accordance with the contract requirements. Reinforced fill shall not be placed under freezing conditions. Reinforced fill shall be placed, spread, and compacted in such a manner to avoid the development of wrinkles and/or displacement of the soil reinforcement. Where retained embankment is to be placed behind the RSS, embankment placement shall closely follow placement of the reinforced fill. Reinforced fill and retained embankment shall be graded away from the slope crest and rolled at the end of each work day to prevent ponding of water on surface of the reinforced soil mass.

A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the soil reinforcement and turning of tracked vehicles shall be kept to a minimum to prevent displacing the soil reinforcement. If approved by IFA, rubber-tired equipment may pass over the reinforcement at speeds of less than 5 mph. Sudden braking and sharp turning shall be avoided. No rubber-tired wheel traffic will be allowed in direct contact with coated geosynthetic geogrid, as damage to the coating could result.

Compaction adjacent to the backside of the facing treatment shall be achieved by use of light weight mechanical tampers, rollers, vibratory system or other methods to provide short- and long-term erosion and facing stability.

For the vegetated facing treatment, the construction of any top soil, compost, seeding, sod, mulching, erosion controls, watering, shall be in accordance with the Standard Specifications unless otherwise specified in the approved shop drawings.

Construction and construction tolerances shall be in accordance with AASHTO Bridge Construction Specifications Section 7 with the following additions or clarifications:

1. A minimum of 1 cubic foot of unit drainage fill shall be used for each square foot of slope face and shall be placed between and behind the facing units and shall extend back from the face of the wall a minimum of 2 feet. Geotextile is not an acceptable substitute for unit drainage fill unless the entire reinforced fill zone is in accordance with Section 7.3.6.3 and connection strength requirements can be met without unit drainage fill.
2. Soil reinforcement shall be staked at the corners and on 12-foot centers along the roll edges to prevent wrinkling or other distortion of the reinforcement during backfill placement.

Basis of Item

The RSS shall be quantified in square feet of vertical projected slope face area. The RSS will be quantified from the top of the RSS to the bottom of the RSS for the length of the slope as shown in the Design Documents. Any additional face area below or above the top or bottom of plan lines to satisfy the design stability requirements or stepping of the facing will be not be measured but considered included in the measured area defined above.

The items list shall include the following:

Item No.	Item Description	Unit Symbol

203-11340 Reinforced Soil Slope .....SFT

The following shall be considered incidental to this item:

Design, supply, and installation of the RSS including any excavation, base leveling pad, foundation soil preparation, soil reinforcement and placement of soil reinforcement, compaction, unit drainage fill, reinforced backfill, retained backfill, facing elements and facing treatment, subdrain, and other items specified on the approved shop drawings, equipment, materials and labor necessary to construct the RSS.

ATTACHMENT 13-2

EMBANKMENT OTHER THAN ROCK, WITH STRENGTH OR DENSITY CONTROL

SECTION 202.23, BEGIN LINE 997, DELETE AND INSERT AS FOLLOWS:

203.23 Embankment other than Rock, with Strength or Density Control

The compaction will be determined by dynamic cone penetrometer, DCP, testing in accordance with ITM 509 and the moisture content in accordance with ITM 506. ~~Soil classification will be performed in accordance with ITM 512 and the following DCP blow counts will be used for compaction control:~~

A test strip shall be constructed for density verification. Density verification for each test strip will be in accordance with AASHTO T 310 in direct transmission mode for each type of material. This test strip procedure shall be used to estimate the number of DCP blow counts to represent 95% percent compaction requirements in accordance with AASHTO T 180.

The test section shall be approximately 225 ft long and 24 ft wide and consist of no less than two lifts and be made where embankment fill is being constructed. The natural ground surface shall be proof rolled in accordance with 203.26 prior to construction of the test section lift. The soil in the test section shall meet the requirements of 203.09 and 203 23. The DCP and moisture acceptance tests on each underlying lift will meet the specification requirements. The moisture acceptance tests on the top lift will meet the specification requirements.

The roller shall be checked to assure that the equipment complies with the specification requirements. The speed of the roller and the frequency of vibratory rollers shall be consistent throughout the test section. There shall be no stopping or turning within the established test section.

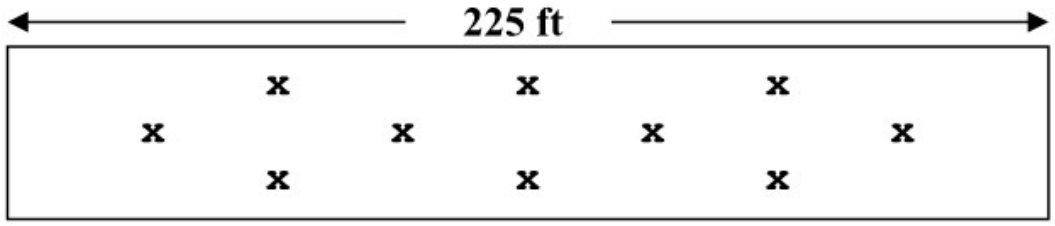
Procedure – Number of Roller Passes

Initially roll the top lift of the test section with four to six applications of the compaction roller.

- Note 1: A roller application is defined as one pass of the roller over the entire test section.

- Note 2: The roller that is used for normal production compaction shall be used for the test section.

Following the initial applications with the compaction roller, obtain 10 random DCP tests for 12 in. in accordance with 203.23 and 10 density tests in accordance with AASHTO T 310 with a 12-in. depth and conducted in direct transmission mode. Tests shall be spaced uniformly throughout the test section at the following locations. Each location shall be marked with paint.



Average the 10 DCP test values and the AASHTO T 310 density test values. When the average of the 10 AASHTO T 310 density tests meet the 95% compaction requirements of AASHTO T 180, the number of roller passes that was used and the corresponding average DCP blow count is reported. The test section is complete.

Additional rolling is required when the average AASHTO T 310 density test values do not meet the 95% compaction requirements of AASHTO T 180. After the additional roller passes are complete, test the same 10 random locations 1 ft from each original test site with the DCP and density test.

The information recorded from the test section shall include the date, location, number of passes to achieve the target density value, average DCP blow count to meet target density and the DCP test data for the initial passes and each additional pass of the roller, and the type of roller used to compact the test section shall be reported.

The moisture compaction range for all soil types shall be as follows:

Soil Type	Moisture Compaction Range
Clay (< 105 lb/cu ft)	-2 to +2% of optimum moisture content
Clay (105 - 114 lb/cu ft)	-2 to +1% of optimum moisture content
Silty and Sandy (> 114 lb/cu ft)	-3% to optimum moisture content
Granular	5 to 8%

DCP testing and verification testing, AASHTO T 310 in direct transmission mode, will be performed in accordance with the Frequency Manual at random locations determined in accordance with ITM 802.

Moisture testing will be performed in accordance with the Frequency Manual.

If the embankment material is too wet or too dry, either the material shall be aerated to remove excess moisture or watered and disked to increase the moisture content, until in either case the moisture content is within the specified range. Sufficient moisture tests will be made to ensure that this range is maintained throughout the embankment.

The embankment material shall be placed in uniform level layers, left properly shaped as set out above, and compacted with approved compacting equipment. Compacting equipment shall include at least one 3-wheel roller or other approved compacting equipment capable of providing a smooth and even surface on the embankment as directed.

Each lift shall be disked or treated by some other mechanical means which shall ensure the

breaking up of any existing lumps and clods.

The loose depth of each lift shall be such that the required compaction can be obtained, but in no case shall it exceed 8 in. Where a tamping roller is used, the loose depth of lift shall not exceed the length of the tamper feet. The surface area of the end of each foot of the tamping roller shall be no less than 5 1/2 sq in.

ATTACHMENT 13-3

Method of Making Strength, Stiffness and Density Tests

SECTION 203.24, LINE 1125, INSERT AND REPLACE AS FOLLOWS:

203. 24 Method of Making Strength, Stiffness and Density Tests

The strength of chemically modified or compacted soils will be determined by DCP in accordance with ITM 509. The stiffness of chemically modified soils or aggregates will be determined by the LWD, in accordance with ITM 508. The density of soils and aggregates, as a percent of compaction, will be based on the maximum dry densities unless otherwise specified or directed. DCP field compaction tests will be performed in accordance with this section. The required compaction shall be obtained before additional material is placed.

(a) Laboratory

The DCP criteria will be established on representative soils by performing ASTM D 1140, AASHTO T 88, AASHTO T 89, AASHTO T 90, and AASHTO T 180 using Method A for soils and Method D for granular materials.

The optimum moisture content, maximum dry density, and gradation of aggregates will be determined by performing AASHTO T99 Method C, AASHTO T 11 and AASHTO T 27 on representative sample of aggregates.

(b) Field

The soil strength of compacted soils or compacted chemically modified soils will be determined by DCP in accordance with ITM 509 and the stiffness of chemically modified soils or aggregates will be determined by LWD in accordance with ITM 508. The moisture content will be determined in accordance with ITM 506 or AASHTO T 255.

At the discretion of IFA, verification of in situ field density and associated DCP values may be performed in accordance with AASHTO T 310 in direct transmission mode to a depth of 12 in. This testing criteria will govern in the event of a discrepancy in the acceptance.

Acceptance testing of chemically modified soils and coarse aggregates will be determined by LWD testing in accordance with ITM 508. The allowable deflection will be determined from a test section or will be specified. Test sections shall be constructed in accordance with ITM 514 in the presence of a representative of the INDOT Geotechnical Services Division for other materials not included in the Tables to determine the allowable deflection. The compaction procedures shall be in accordance with 203.23, 215, 301, 302, and 303. Proofrolling of compacted aggregate shall be performed in accordance with 203.26.

The allowable average deflection and maximum deflection for chemically modified soils, aggregate over chemically modified and untreated soils shall be in accordance with the following

Table 1. Allowable Average Deflection and Maximum Deflection for Chemically Modified Soils and Aggregate over Chemically Modified Soils

Material Type	*Allowable Average Deflection (mm)*	*Maximum Deflection at a Single Test Location (mm)*
Lime Modified Soil	*≤ 0.30*	*0.35*
Cement Modified Soil	*≤ 0.27*	*0.31*
Aggregate over Lime Modified Soil	*≤ 0.30*	*0.35*
Aggregate over Cement Modified Soil	*≤ 0.27*	*0.31*

Table 2. Aggregate over Untreated Soils: Where Proofrolling Can Be Performed

Material Thickness	*Allowable Average Deflection (mm)*	*Maximum Deflection at a Single Test Location (mm)*
6 in. Thick Coarse Aggregate No. 53	*≤ 0.51*	*0.57**
12 in. Thick Coarse Aggregate No. 53	*≤ 0.34*	*0.40***
18 in. Thick Coarse Aggregate No. 53	*≤ 0.31*	*0.35*

** When deflection exceeds this value, the area shall be recompacted or undercut as directed. The failed area will be delineated prior to excavation. Deflection will be measured based on the top 6 in. thick coarse aggregate No. 53 material placed for undercut.*

*** The Design-Build Contractor shall recompact the coarse aggregate No. 53 in accordance with 301.06*

Table 3. Aggregate over Untreated Soils: Where Proofrolling Cannot be Performed

Material Thickness	*Allowable Average Deflection (mm)*	*Maximum Deflection at a Single Test Location (mm)*
6 in. Thick Coarse Aggregate No. 53	*≤ 0.60*	*0.65**
12 in. Thick Coarse Aggregate No. 53	*≤ 0.47*	*0.52***
18 in. Thick Coarse Aggregate No. 53	*≤ 0.44*	*0.49***

** When deflection exceeds this value, the area shall be recompacted or undercut as directed. The failed area will be delineated prior to excavation. Deflection will be measured based on the top 6 in. thick coarse aggregate No 53 material placed for undercut.*

*** The Design-Build Contractor shall recompact the coarse aggregate No. 53 in accordance with 301.06.*
Note: IFA will perform the moisture test on in-situ soils prior to placement of coarse aggregate. If the result of the moisture test is > 13%, IFA will contact the Geotechnical Section.

Acceptance of the compaction of chemically modified soils or aggregate will be determined by averaging three LWD tests obtained at a random station determined in accordance with ITM 802, for each 1,500 ft length of chemically modified soil for each two-lane pavement section, or for each 800 t of compacted aggregate. Where the construction area is 8 ft wide or more, the location of the three tests will be at 2 ft from each edge of the construction area and at 1/2 of the width of the construction area. Where the construction area is less than 8 ft wide, the location of the three LWD tests will be spaced at 1/2 of the width of the construction area and spaced 5 ft apart in the longitudinal direction. The average deflection shall be equal to or less than the maximum deflection determined by the test section.

If the average deflection is not equal to or less than the maximum deflection for aggregates, a sample of the aggregate shall be obtained in accordance with AASHTO T 2 and a moisture content test shall be performed in accordance with AASHTO T 255 or ITM 506 to determine if the moisture content is within the acceptable limits. If the moisture content is not within the acceptable limits, additional LWD tests may be taken at the same locations after 24 h if the moisture content is within the acceptable limits at the time of testing. The aggregate will be accepted if the LWD tests are equal to or less than the maximum deflection.

ATTACHMENT 14-1

UNIQUE SPECIAL PROVISION

Bridge Deck Longitudinal Grooving

NEXT GENERATION CONCRETE SURFACE

Description

This Work shall consist of construction of the Next Generation Concrete Surface, NGCS, on newly constructed bridge decks, continuously reinforced concrete pavements and portland cement concrete pavements, PCCP, using diamond grinding and grooving techniques in accordance with 105.03.

Equipment Requirements

The grinding shall be completed by mechanical grinding equipment in accordance with 508.08(c) and the equipment shall weigh a minimum of 35,000 lbs including the grinding head and be of a size that will grind a strip at least 4 ft wide in a single pass. Grinding equipment that causes raveling, aggregate fractures, spalls, or disturbance to the transverse or longitudinal joints shall not be permitted. The equipment shall have a positive means of vacuuming the grinding residue from the pavement surface leaving the surface in a clean, near-dry condition.

The equipment shall be maintained to ensure it is in proper working order, with attention paid to the roundness of the match and depth control wheels. Any wheels found to be out of round shall be replaced immediately.

Construction Requirements

The construction operation shall be scheduled and proceed in a manner that produces a neat, uniform finished surface. Shoulder, auxiliary or ramp lane grinding shall transition from the edge of the mainline as required to provide drainage, leaving no more than a 3/16 in. ridge and an acceptable riding surface. When conditions require a feather pass into the shoulder, auxiliary or ramp lanes, conventional diamond grinding shall be used. Joint sealing shall be completed subsequent to the diamond grinding operations and shall be installed in a recessed condition.
NGCS construction shall be accomplished using a two-pass operation as described herein.

The Design-Build Contractor shall construct a single lane NGCS test grind 500 ft in length to demonstrate that the equipment and procedures used are capable of attaining the desired surface texture and smoothness requirements. The Design-Build Contractor shall not proceed beyond the test grind limits until the test grind has been approved in writing by IFA.

Grinding shall be accomplished in a manner that eliminates joint or crack faults so there is no more than a 1/16 in. differential between the adjacent sides of the joints and cracks. Grinding shall also substantially remove pavement conditions such as warp and curl to provide an acceptable ride in accordance with the smoothness requirements described herein.

Lateral drainage shall be achieved by maintaining a constant cross slope between grinding extremities in each lane. The finished cross slope shall mirror

the pre-grind cross slope and shall have no variations of slope greater than 1/8 in. when measured with a 10 ft straightedge placed perpendicular to the centerline. Smoothness requirements will not apply to areas outside the ground area.

Grinding shall begin and end at lines normal to the pavement centerline at the project limits. Passes of the grinding head shall not overlap more than 1 inch. No unground surface area between passes will be permitted.

This work shall be constructed in two separate operations. The first operation will create the flush ground surface. The flush grind blades shall be mounted on a 4 ft grinding head, stacked with 1/8 in. wide blades separated by 0.035 +/-0.005 inch wide spacers. The blades used to produce the flush ground surface shall be flat across their contact surface and in the same plane with other flush grind blades when mounted. The complete head, when stacked with all blades, shall be straight across its length without bowing when mounted on the diamond grinding machine. No unground surface area between passes will be allowed. The surface shall meet the smoothness requirements described herein.

The second operation will provide the longitudinal grooves. The longitudinal grooves shall be 1/8 in. wide and will be 1/8 in. to 3/16 in. in depth. The longitudinal grooves shall be spaced on 1/2 in. to 5/8 in. centers. The grooves shall be constructed parallel to the centerline. The Design-Build Contractor shall use a guide to ensure proper alignment of the grooves to centerline.

Final Surface Finish

The NGCS grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal grooved texture. The flush ground surface shall appear smooth and shall contain no ridges that exceed 1/32 in. The longitudinal grooves shall be constructed parallel to the centerline. All of the pavement surfaces specified shall be textured utilizing the NGCS unless approved by IFA.

Slurry Handling and Removal

The operation shall be coordinated such that the slurry or residue materials are continuously removed from the pavement. The slurry shall not encroach into adjacent pavement lanes carrying traffic, or flow into gutters or other drainage facilities and shall be immediately and directly deposited into a tanker truck and removed from the jobsite. Final disposal of the material shall be in an approved manner and in accordance with 104.07.

Smoothness Requirements

Each segment of the finished NGCS shall be in accordance with 501.25. The requirements of 501.28(d) shall not apply. Surfaces shall be measured for smoothness acceptance following the flush grinding operation and prior to the longitudinal grooving operation.

The finished ground surface shall not include any bumps exceeding 0.3 in.

ATTACHMENT 14-2

UNIQUE SPECIAL PROVISION

FINGER EXPANSION JOINT

Description

This work includes the fabrication, furnishing and installation of a tooth expansion joint with a fabric reinforced drainage trough for highway bridge joints. Materials and workmanship shall be in accordance with the INDOT Standard Specifications; AASHTO/AWS D1.5M/D1.5 "Bridge Welding Code"; AWS D1.1/D1.1M "Structural Welding Code – Steel"; AASHTO "LRFD Bridge Design Specifications", 8th Edition (AASHTO LRFD Design); AASHTO "LRFD Bridge Construction Specifications," 4th Edition, 2017 (AASHTO LRFD Construction); the Contract Documents; and this Special Provision.

Materials

Materials shall conform to the following:

A. **Structural Steel.** Steel plate, bars and shapes shall conform to AASHTO M270 (ASTM A709), Grade 50. (Sidewalk and (railing) cover-plates shall conform to AASHTO M270, Grade 50). No aluminum components or hardware shall be used. Galvanize steel components in accordance with ASTM A123.

B. **Welded Studs.** Welded studs for anchorage purposes shall conform to ASTM A108.

C. **Anchors Bolts.** Anchor bolts, nuts and washers shall be in accordance with ASTM F1554, Grade 55, ASTM A563 Grade DH and ASTM F436, respectively, and shall be hot-dipped galvanized.

D. **Neoprene Trough.** Fabric reinforced drainage trough shall be polychloroprene (Neoprene) of the thickness great than ¼". Trough shall be reinforced with one or two plies of tightly woven polyester or nylon fabric and shall be supplied and installed in one continuous length. The inside surface of the trough shall be smooth to promote self-removal of foreign material during normal joint operation. The shape of the trough shall be designed to minimize stress concentrations at compression strips.

The trough shall have a minimum 3-inch gap and have space for transverse movement. The slope of the trough shall be the maximum allowed by the geometry of the bridge. A fiberglass drain box/collector shall be at each end of the trough with no chock points or impediments to trough movement or debris flow. The trough shall be detailed to avoid contact with the stringer ends. The fiberglass drain pipe shall be a minimum of 9 inches in diameter.

Neoprene/fabric composite material shall comply with the following:

PHYSICAL PROPERTY	ASTM TEST	VALUE
Density		75 psf minimum
Hardness (Type A Durometer)	D2240	50 to 75 points
Tensile Strength, both directions	D378	800 lbs/in. minimum
Elongation @ ultimate tensile strength	D412	35% maximum
Tear (Die C)	ASTM S624	120 lbs/in. minimum
Low Temperature Brittleness (22 hrs. @ -20^0F, then wrapped around a 3 inch mandrel)	ASTM D2137	No cracks
Ozone Resistance (20% Strain) 100 pphm in air (100 hrs. @ 100^0F)	D1149	No cracks

E. **Drainage Trough Hardware.** Plates, fasteners, washers and nuts shall be stainless steel conforming to ASTM A240, ASTM F593 and ASTM F594.

Fabrication

Tooth plate assembly may be fabricated in two pieces with a joint at the roadway crown (Option 1.) Alternatively, plate assembly may be fabricated in segments with individual lengths not less than 11’-0” (segmented joint) provided that segment joints occur at the crown line and within 1’-0” of roadway lane lines (Option 2.) Tooth plates for each assembly shall be cut from a single plate by burning in such a way that, after the plate is cut and the toothed plates placed in the same relative position as before burning, no part of the cut shall be wider than 5/16 in. Anchor holes, vent holes and tapers shall be machined into the plate. Upon completion, the machined plate shall be galvanized per ASTM A123.

The joint segments shall be manufactured and delivered in pairs of independent elements with parallel gaps between teeth. Both halves (abutment and superstructure, or each side of adjacent units) of finger expansion joints shall be fully assembled in the shop to ensure that full joint closure can be attained without binding of fingers. After joint segments have been fully assembled to nominal joint dimensions and approved, they shall be match marked and scored (the upper surface of the finger plates shall be permanently scored to provide two or more parallel lines in both directions) to aid in proper field installation.

Sampling, Testing, & Inspection

An independent laboratory, to ensure compliance with these provisions, shall test each lot of composite neoprene/fabric sheeting. Two certified copies of the qualification test data indicating that the tested materials comply with these provisions shall be submitted to the IFA. The sample from each lot shall be one 6-inch piece, 2-foot long.

Identification, Shipping & Handling

Expansion joint openings shall be preset prior to shipment and assembled with temporary shipping angles at maximum 5'-0" centers. Fabricator shall show details of all shipping and erection temporary attachments on the shop drawings.

Installation

Installation of the expansion dam shall be to the lines and grades shown on the plans and in accordance with Contract Documents and shop drawings. Expansion joint system shall be shipped to job site preassembled for units either side of crown line (Option 1) or for the fabricated segment lengths (Option 2).

Align the finger plate or sliding plate joint assemblies in position and check the expansion opening. The expansion opening must be adjusted for temperature prior to bolting, welding or placing concrete on each side of the joint.

Test fit the finger plates or sliding plates with all the armoring and anchorages in place. Install the finger joint centered over the expansion gap, for both fingerplates and sliding plates. Verify that the joint is in plane and sloped per the roadway. For Fabrication Option 2 align adjacent finger plate assemblies using temporary angles bolted to the assemblies. Make sure the fingers do not rub during the full range of temperature movement.

The Engineer will confirm the procedure, opening and alignment prior to concrete placement. After confirmation, remove the finger plates or sliding plates before concreting. Cast and cure the expansion joint blockout per INDOT specifications. Place concrete under the expansion dams, vibrate until the concrete is forced through air holes, and strike off excess concrete. After the concrete has cured, clean air holes and fill with an approved sealer.

Install the fabric trough and the finger or sliding plates according to the Contract Documents and shop drawings. Do not splice the drain trough, unless indicated. If splices are indicated, use splices vulcanized by the manufacturer. Do not use longitudinal splices.

Submittals

Submit shop drawings, for each location, type and model of expansion device used. Shop drawings shall include, but not be limited to, the following:

A. Complete details of all components and sections showing all materials used in the expansion joints.
B. A listing of all applicable INDOT, ASTM and AASHTO specifications.
C. Name and address of the manufacturer, and location of the fabrication plant.
D. Name and telephone number of the manufacturer's representative who will be responsible for coordination of production, inspection, sampling and testing.
E. Welding procedures used in the expansion joint assembly manufacture clearly described and detailed.
F. Table of longitudinal offsets for installation at varying temperatures. Use 60°F as the mean temperature.

Joint shop drawings and neoprene trough shop drawings shall be coordinated to ensure that joints and troughs will fit when field assembled. Fabrication shall not commence until the approved shop drawings are in the hands of the Inspector and fabricator and IFA has authorized fabrication.

ATTACHMENT 14-3

UNIQUE SPECIAL PROVISION

LINK SLAB

Description

The number of deck joints shall be minimized to the extent practical to minimize future maintenance and to accommodate superstructure movement. Joints shall be replaced with a link slab system. The link slab system used shall be Ultra-High-Performance Concrete (UHPC) with design in a method acceptable to the INDOT Office of Structural Design or with fiber reinforced concrete according to the following specifications for Structural Concrete (Link Slab).

If fiber reinforced concrete is used then INDOT standard concrete mix design for bridge deck (Class C) shall apply for the link slab concrete except modified to include fiber reinforcement as specified herein.

Use a combination of micro and macro non-metallic synthetic fibers to provide crack control and improve the long-term performance of the bridge decks. The maximum allowable slump may be increased by 1 inch for concrete mixes that include these fibers. Incorporate the fibers into the mix design in accordance with the applicable requirement of the INDOT Standard Specifications.

Material

Supply synthetic fibers for the stated purpose of controlling plastic shrinkage cracks in PCC and to provide increased residual flexural strength in the concrete. The supplied fibers should meet INDOT Reoccurring Special Provision (RSP) 912-M-050 and come from one of the products from INDOT's approved list.

Manufacturer Product Name	Addition Rate:
ABC Polymer Industries, LLC FIBERFORCE 650 (1.5" length only)	4.5 lbs/cyd
ABC POLYMER INDUSTRIES, LLC FIBERFORCE 1000 HP (2" length only)	4.5 lbs/cyd
BASF CORPORATION MASTERFIBER MAC MATRIX (2.1" length only)	4.5 lbs/cyd
BASF CORPORATION MASTERFIBER MAC 360 FF (2" length only)	4.0 lbs/cyd

THE EUCLID CHEMICAL CO TUF-STRAND SF (2" length only)	4.0 lbs/cyd
FORTA CORPORATION FORTA-FERRO ONE (2.25" length only)	5.0 lbs/cyd
GCP APPLIED TECHOLOGIES STRUX 90/40 (1.55" length only)	4.5 lbs/cyd

Supply a written statement from the manufacturer of the fibers verifying the compatibility of the combination of materials and the sequence in which they are combined, to IFA prior to using it in this project.

Assure fibrous concrete conforms to ASTM C1116, "Standard Specification for Fiber Reinforced Concrete". Incorporate at a minimum rate of 4 pounds per cubic yard or the manufacturer's recommended dosage. Furnish fiber manufacturer's documentary evidence of satisfactory performance history and compliance with ASTM C1116 Type III.

Construction Requirements

Identify dedicated personnel involved in introduction of fibers to mix to IFA. Add synthetic fiber reinforcement into concrete mixer using one of the following methods:

1. Open bag and distribute fibers on aggregate belt at ready-mix concrete plant.

2. Open bag, break apart any fiber clumps, and introduce fibers into ready-mix concrete truck in a well-distributed manner, that is "chicken feed".

Mix synthetic fiber reinforcement in concrete mixer in accordance with mixing time and speed of ASTM C94, "Standard Specification for Ready-Mixed Concrete" to ensure uniform distribution and random orientation of fibers throughout concrete.

Other methods to add fibers to the concrete mix may be submitted for approval by IFA following demonstration of the method by a successful trial placement. Ensure the manufacturer's technical representative is available by phone or in person to troubleshoot fiber inclusion into the mix during the trial placement and bridge deck placement.

Trial Batch and Test Placement:

In addition to a flexural strength test in accordance with ASTM C293,

contractor is required to produce a test batch and test placement.

Allow District Testing Engineer (DTE) ample opportunity to witness trial batching. Provide DTE notice and mix proportions 7 calendar days prior to this event.

Mix trial batch (a minimum of 3 cubic yards in size) at least 30 calendar days prior to planned placement. Establish batching sequence of materials during trial batch.

The test batch shall be 8 inches in thickness and 100 square feet minimum in plan dimensions. Two layers of epoxy coated reinforcement shall be placed in a test batch with a similar bar size, spacing and minimum clearance to those for the production link slabs as shown in the contract plans. Place and consolidate using methods typical for bridge deck pours. Finish concrete by hand and evaluate mix workability and finishability for intended application and method of placement. The test placement may be directly poured on grade. Contractor is required to demonstrate the proposed placement and finishing processes.

ATTACHMENT 14-4

UNIQUE SPECIAL PROVISION

STRUCTURAL REPAIRS: HANGER REPLACEMENT

Description

This work shall consist of furnishing all labor, materials, equipment, services and incidentals necessary and design, fabricate, and install a complete and functioning hanger system to replace the existing hangers at panel points 3 through 19 on both East and West truss of Spans 1 and 2 in accordance with 105.03.

Each hanger shall consist of two individual strands with anchor sockets connected to the existing structure under the lower chord at top and above the floor beam flange at bottom. The Contractor may utilize the existing anchor socket holes at those locations for the new hanger connection design to the existing structure. Existing turned bolts shall be replaced with new turned bolts. New holes shall match the existing holes in size and alignment when bolting new steel to existing steel. Replacement hangers and connections shall be designed for HS20-44 loading in accordance with 2002 *AASHTO Standard Specifications for Highway Bridges, 17th Edition*, and shall be designed for actual dead loads.

The structural strand shall be designed for a safety factor of 3:1 for breaking strength versus unfactored dead load plus live load and impact.

Hanger replacement work shall include the work to furnish and erect a temporary support system designed to support the floor beam during the hanger replacement process. This shall include temporary jacks, materials, and appurtenances needed for the safe removal and disposal of the existing cables and associated hardware and load transfer to the hanger replacement cables.

Hanger replacements shall be constructed in phases as necessary to accommodate the MOT Plans and the maintenance of traffic requirements.

If required by the work sequence, a portion of the existing concrete bridge deck coping shall be removed as necessary to construct the temporary hangers. Anchored temporary barriers shall be provided across open areas in the coping.

The work shall also include testing of the existing hanger strand system to measure dead load tension in the existing hanger cables, including the purchase or rental of required equipment to perform the testing.

The work shall also include testing the existing hanger strands for any residual tension following load transfer to the temporary support, and prior to cutting and removing the existing hanger strands.

The work shall also include monitoring the distance between the upper and lower hanger anchor points before, during, and after replacement in order to verify that this distance is not altered during the cable replacement process.

The work shall also include cleaning and spot painting of existing steel work wherever the existing paint coatings have been damaged or disturbed by the hanger replacement work to three (3) inches beyond all such areas affected by the replacement work in all directions. Steelwork exposed to the environment by

removing the existing hanger system shall be considered as disturbed and shall be spot painted as a part of the work. Spot painting shall use the Partial Paint System in accordance with 619. Galvanized materials shall not be cleaned or painted and shall be protected from overspray during painting operations. Any damaged galvanized surfaces shall be repaired in accordance with ASTM A780-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coating.

Materials

Fabricated Structural Steel

Structural steel shall be grade 50 or higher and in accordance with 910.02 meeting Charpy V-notch requirements of temperature zone 2 as specified in AASHTO LRFD Bridge Design Specifications, 8th Edition Section 6.6.2.1.

Fabrication shall be in a fabricating plant that is certified in ABR (Certified Bridge Fabricator-Advanced (Major) under the AISC Quality Certification Program in accordance with 711.04(b)3.

High Strength Bolts

Bolts shall be ASTM F3125, Grade A325 (AASHTO M164) and in accordance with 910.02. Grade A490 may be used with temporary connections.

Where required, turned bolts shall be new galvanized ASTM A449 Type 1 high strength turned bolts and ASTM A53DH heavy hex nuts. All bolts, nuts, and washers to be galvanized shall be in accordance with ASTM B695 (AASHTO M298, class 50). The turned body of the bolt shall be 1/16" larger than the nominal thread size.

Structural Strand

Structural strand shall conform to ASTM A586 Grade 1, Class A weight zinc-coated inner wires and Class C weight zinc-coated outer wires. The inner wires shall be lubricated with Prelubeor 19 corrosion inhibiting grease manufactured by Grignard Company, LLC or equivalent, which shall be injected during manufacturing of the strand which will provide additional corrosion protection for the inner wires.

Strands shall have a minimum breaking strength of 376 tons. All strands shall be pre-stretched to 55% of the breaking strength in accordance with ASTM A586. A minimum modulus of elasticity of 23,000ksi shall be required for pre-stretched strands for Class C weight of zinc-coated outer wires.

The manufacturer of the structural strand shall be ISO 9001 certified

Socket Assemblies

All anchor sockets shall be cast steel conforming to ASTM A148. Sockets and the socketed zinc connections shall at least be Grade 105/85 and meet or exceed 100% of the breaking strength of the designated structural strand attached. Each socket installed as part of the structure shall be proof loaded to 55% of the breaking strength of the attached structural strand following attachment of the structural strand.

All anchor sockets and components shall be Class A galvanized conforming to

the requirements of ASTM A153. One end of each cable assembly shall be an adjustable socket with the adjustable range large enough to accommodate that required for cable elongation and constrction tolerance and allows for tensioning the cable.

Pin holes for open strand sockets shall be line bored in accordance with 711.38. Provide a pin hole diameter that does not exceed that of the pin by more than .0625 inches as measured on the galvanized surfaces. The galvanizing thickness on the inside surface of the pin hole where it contacts the pin shall not exceed .03125 inches.

All socket pins shall have one end headed and one end fitted for a retaining device. The pin retaining device may be a threaded pin cap or cotter pin. The pin head and retaining device must be capable of sustaining a force along the axis of the pin equal to or greater than 5% of the minimum breaking strength of the attached structural strand. Charpy V-notch testing shall be performed per ASTM E23 at 40 ˚F on one pin per lot and the results shall be submitted to IFA.

All components shall be designed to develop the minimum breaking strength of the attached structural strand without experiencing stresses beyond the yield point of the socket steel or excessive creep of the zinc filler under load. All sockets, rods and pins shall be considered fracture critical and shall adhere to the requirements of AASHTO/AWS D1.5.

All sockets shall be fully inspected by magnetic particle examination conforming to ASTM A 781, supplemental requirement S1 in accordance with:

a. ASTM E 709 – Standard Guide for Magnetic Particle Testing
b. ASTM E 125 – Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings.

Each socket type shall be subjected to radiographic examination conforming to ASTM A781, supplemental requirement S2. Contractor shall submit radiographic shot schedule of castings to IFA for approval for each socket type.

Radiographic inspection shall be performed by the Contractor and witnessed by IFA or their representative in accordance with the following specifications, as applicable:

a) ASTM E 94 – Standard Guide for Radiographic Examination.
b) ASTM E 446 – Standard Reference Radiographs for Steel Casting up to 2 inches in Thickness.

The surface of the casting shall be examined visually and free of adhering sand, scale, cracks and hot tears.

Large sand spots, inclusions and blow holes, as determined by IFA or their representative, shall be cause for rejection of the casting.

Defects exceeding the degree shown in the following table shall be cause for rejection of a socket.

Table 1: SEVERITY LEVEL – RADIOGRAPHICALLY INSPECTED CASTINGS*

Category	Defect	Acceptable

ASTM E446 up to 2 inches		Severity Level**
A	Gas Porosity	3
B	Sand Slag Inclusions	3
C	Shrinkage:	
	Type 1	3
	Type 2	3
	Type 3	3
	Type 4	3
D	Crack	Not Acceptable
E	Hot Tear	Not Acceptable
F	Insert	Not Acceptable
G	Mottling	Not Acceptable

If a socket is rejected, all other sockets from the same heat shall be radiographically inspected at no additional expense.

Rejected castings may be repaired at the sole discretion of IFA. If approved by IFA, repairs shall be performed repairs at no additional expense. Minor defects may be removed by grinding or chipping without welding repair, provided the following requirements are complied with:

- The depth of the defect does not exceed 3% of the specified dimension.
- The removal of metal does not appreciably affect the strength of the casting, as determined by the Engineer of Record.
- The remaining wall thickness is equal to or greater than the required wall thickness.
- The surrounding metal is ground to a smooth contour with the elimination of apparent stress risers.

Defects exceeding those defined above may be repaired by welding if approved by IFA. All proposed repair procedures shall be submitted to IFA in writing. The request shall include a description of the defect, the size and shape of the excavation, the welding specification, and the amount of preheat and post heat to be utilized.

Contractor shall perform and provide certification for radiographic inspections to IFA for review and approval. Inspections shall be performed by approved American Society for Nondestructive Testing ASNT-TC-1A examiners.

The anchor sockets shall be Charpy V-notch impact tested in accordance with ASTM A 781, supplemental requirement S9. The testing frequency shall be performed at the same frequency as for the radiographic testing. The samples shall withstand an impact of 25 foot-pound at 40˚F. Contractor shall submit the documented results to IFA.

Pins

Pins connecting the open strand sockets to the anchor plate shall conform to the requirements of ASTM A668, Class F. Supplemental requirement S6 magnetic particle test and S7 ultrasonic test shall apply. Ultrasonic testing shall be performed at the same frequency as for the radiographic testing of the anchor sockets.

Charpy V-notch impact testing shall be performed on the pins in accordance with ASTM A673, P frequency. The samples shall withstand an impact of 25 foot-pounds (force) at 40˚F.

Pins shall be fabricated in accordance with 711.37. Pins shall be galvanized in accordance with ASTM A153. The galvanizing thickness on the pin shall not exceed 0.03125 inch.

Cotter Pins

Stainless steel type 316 cotter pins shall be supplied.

Construction Requirements

Field Verification

Complete field survey and measurement of all steelwork and work locations shall be performed as necessary to furnish complete and accurate shop drawings. Adjustment or modification in the field may be necessary to assure a reasonable fit.

Shop drawings of the existing materials are available for the Contractor's use. However, field measurements shall be taken to confirm dimensions where necessary. Fully dimensioned shop drawings of all new materials, superimposed on existing materials shall be submitted in accordance with 105.02.

The Contractor shall verify the dead load tension in the existing hanger strands prior to performing removal work. The testing procedure proposed for use shall be submitted to IFA for review and approval prior to performing any testing at the bridge. The Contractor shall perform tension testing to approximate a "no live load" condition and shall specify means to achieve a minimal live load forece effect in the testing procedure.

A complete summary of all hanger dead load tension readings shall then be provided to IFA for review and approval upon completion of the testing. The approved dead load summary table shall be submitted to the hanger strand manufacturer for use prior to fabrication of any hanger strands.

Temporary Jacking

The Contractor shall be responsible for design, fabrication and construction of all temporary jacking systems required to support the relevant in-service loads and construction loads. Calculations and working drawings shall be submitted to IFA for all temporary jacking systems and related component designs in accordance with 105.02. All design calculations shall conform to the design criteria and shall be signed and sealed by a Licensed Engineer in the State of Indiana.

All jacking operations shall be performed in the presence of IFA or their representative. Actual jacking forces, including increments of application at each jack, shall be carefully monitored and recorded. The relative displacement of the floor beam shall not exceed 1/8" from the reference datum. The actual deflection of the floor beam shall be continuously monitored during jacking operations.

Following jacking operations, the Contractor shall test the existing hanger strand at each truss panel point to ensure that all load has been successfully

transferred to the temporary support and no residual tension is carried by the existing hanger strand prior to its cutting and removal. Flame cutting shall not be used to cut the hanger unless all load has been removed from the hanger. The method for performing this testing shall be defined by the Contractor as part of the jacking procedure, which shall be submitted to IFA for review and approval in advance of any jacking operations at the site.

Jacking during hanger installation operations shall not be allowed and/or shall be ceased immediately when the sustained wind velocity exceeds 30 mph. The Contractor shall only perform jacking and load transfer between the existing and replacement hangers at one truss panel point location at a time anywhere on Span 1 and 2 separately or concurrently. However, the Contractor shall be allowed to perform all other work concurrently along both the East and West trusses.

Local spot painting shall be performed whenever existing paint coats are disturbed and may be staged concurrently along the East and West trusses. The limits of the spot painting shall be an additional three inches beyond all areas affected by the Contractor on all sides. All new galvanized steel shall be protected from overspray during spot painting operations.

Fabrication and Testing

Working drawings for all hanger assemblies suitable for approval for construction purposes relevant to the hanger replacement work shall be submitted in accordance with 105.02. Fabrication or construction shall not start on an item of work before working drawings are approved. Working drawings and design calculations shall be signed by and sealed by a professional engineer registered in the State of Indiana.

Erection plans shall be submitted which completely describe the method of erection and jacking procedure. Details of all false work, guys, lifting devices, hydraulic jacks and attachments to bridge members shall be included. An erection sequence for all anticipated phases and conditions of erection showing crane capacities and crane locations and lifting points shall also be included. Cable force calculations shall be provided to demonstrate that the cable allowable stress will not be exceeded.

All structural strand, socket components and socket installation shall be performed by a fabricator having a minimum of 10 years of experience in the manufacturing of the specific components. The fabricator shall submit their quality procedures plan and manual to the IFA for review.

The fabricator’s quality procedures plan and manual are subject to approval by IFA. Fabricators of structural strand, cast sockets, and pins shall demonstrate a familiarity with procedures required to produce fracture critical members in accordance with a fracture control plan as defined by AASHTO/AWS D1.5.

At the time the structural strands are measured, a permanent paint stripe shall be placed on the top surface along the full length of the strand which shall be referenced to eliminate any change in length of the hanger strand due to twisting.

All hanger assemblies shall be preassembled and delivered to the site as complete units. The hanger assemblies shall be packaged on reels with a minimum diameter of 5 feet. The structural strand after it is pre-stretched shall not be pulled into a curve smaller than 5 feet.

Certification of the following type shall be submitted to IFA in accordance with 916.02:

- Manufacture of strand, type C
- Tensile strength of strand, type B
- Modulus of elasticity of strand, type B
- Pre-stretching, measuring, and proof loading, type B
- Material certification of sockets and pins, type C

Testing and Fabrication of Wire, Strand and Sockets

Wires used in each hanger shall be made in one continuous piece. The splicing of wire will not be allowed. Strand shall be of long lay but shall not be of such length to prevent keeping the center in its true position during any of the operations before the hangers are in their final positions.

Testing of Wire for Strand:

Prior to fabrication, the zinc-coated steel wire used in the manufacture of structural strand shall be tested for physical properties in accordance with ASTM A586 and the following:

a. No less than 10 percent of the coils of any lot of zinc-coated wire shall be tested for tensile strength. If any of these coils fails to meet the requirements, IFA may require that all coils of such lot be tested and reject all individual coils which do not meet the requirements for tensile strength.
b. No less than 10 percent of the coils of any lot of zinc-coated wire shall be tested for stress at 0.7 percent extension. If any of these coils fails to meet the requirements, IFA may require that all coils of such lot be tested and reject all individual coils which do not meet the requirements of stress.
c. No less than 5 percent of the coils of any lot of zinc-coated wire shall be tested for zinc coating (weight and adherence). If any of these coils fails to meet the requirements, IFA may require that all coils of such lot be tested. Unless at least 80 percent of the coils pass the test, the entire lot will be rejected.

Any coil failing to meet the requirements will be rejected.

Fabrication of Structural Strand:

The strand shall be manufactured to meet or exceed the strength requirements specified herein. Documentation of compliance with these requirements and make-up of the wires in the strand shall be submitted to IFA.

The strand shall be manufactured in machines of adequate size to ensure first-class workmanship and fabrication to the final length. Once the manufacture of strand has started, no changes shall be made in wire grade, construction, or lay of strand, or other factors that would affect the uniformity of the finished product. Bent wires shall not be straightened or used. Any kinked or damaged strands will be rejected

All strands shall be pre-stretched by stressing each strand with a load equal to 55 percent of the breaking strength in straight tension. The load shall be maintained and/or repeated until the strand reaches a stable condition and shows a well-defined and uniform elastic stretch and recovery under stressing. The modulus of elasticity shall be determined in accordance with ASTM A586. This information shall be submitted to IFA.

A test for modulus of elasticity and breaking strength shall be performed for each manufactured length of strand in accordance with ASTM A586. The gauge length of the specimen shall be 100 inches. The strand shall have the anchor sockets attached to each end and shall be loaded through the sockets. The socketing procedures used for the test specimen and assemblies shipped to site shall be identical.

If the test specimen fails to meet the minimum breaking strength requirement, another test sample shall be cut from the same manufactured length and tested. Should it also fail, the manufactured length of strand shall be rejected. If rejected, the contractor shall furnish new strand length that is subject to the same testing and approval procedures outlined herein. No compensation will be made for the cost of the rejected strand, including testing costs. All tests results shall be submitted to IFA for review and approval.

The strand hanger lengths shall be measured after prestressing using calibrated steel tapes while under a known tension equal to the dead load shown on the erection plans. After marking for length, the load shall be released and then reapplied. A second measurement shall be taken and the two measurements shall check within a tolerance of 0.25 inches.

At the time strands are measured for cutting, a continuous paint stripe shall be made on one side of the strand for its entire length to assure correct alignment of the strands during socketing and erection.

The strand shall then be cut and the sockets shall be put on carefully to ensure socket and strand alignment. The sockets shall be attached to the strands by using zinc as specified in ASTM B6, and using a reliable method that will not permit the strand, when stressed to 100 percent of minimum breaking strength under the test specified hereafter, to slip more than 0.5 inches. If a greater movement should occur, the method of attachment shall be changed until a satisfactory one is found. Each end fitting of the finished assembly shall be proof-loaded to a minimum of 50 percent of the strand breaking strength.

When cutting the strand, an allowance for obtaining test specimens shall be included.

Strand identification marks shall be provided to facilitate erection. Each strand shall be marked with a legible waterproof tag attached to it giving the fabricated length and cable ID number as noted in the erection plans.

Strands shall be properly coiled on reels in such a manner so that no permanent deformation of wires in the strand will occur. Strands shall be stored in a well-protected location. Strands shall be handled, transported, and stored in accordance with the AISI Wire Rope Users' Manual. Any strands damaged by the handling, transporting or storing shall be replaced at the Contractor's expense.

Socket Finishing

All sockets shall be given a visual inspection and evaluated for defects.

Practice A802 or other visual standards may be used to define acceptable surface discontinuities and finish. Such visual inspection shall be performed by an independent commercial testing laboratory approved by IFA. Visual surface discontinuities that are unacceptable shall be removed and the removal verified by visual examination of the resultant cavities.

Non-destructive tests shall be performed by the same approved laboratory, in accordance with the appropriate Supplementary Requirements of ASTM A781. IFA will determine the acceptability of sockets evaluated in accordance with this standard.

Any socket that is unacceptable shall be replaced; or alternatively, the contractor may propose the use of other non-destructive test methods to establish the acceptability and/or repairability of the socket. Those test methods, done at the expense of the contractor, may include, for example, radiography, ultrasonic, magnetic particle or dye penetrant. For those sockets that are repaired, follow-up non-destructive tests, at no cost to the Department, shall be performed to verify the success of the repair procedure. IFA shall evaluate the acceptability and/or repairability of a socket based on the results of the tests conducted and shall be the sole judge as to the suitability of a repaired casting.

Sockets shall be neatly finished to the exact dimensions of the selected style. A qualified independent inspector hired by the Design-Build Contractor and approved by IFA shall visually examine each socket for defects. Defects judged to be unacceptable by the independent inspector shall be repaired to the satisfaction of IFA or the socket shall be replaced with a new casting. The basis for allowing a socket to be repaired shall be at the discretion of IFA. Additional non-destructive tests to determine the type and amount of repair and where repairs are required shall be performed at each unacceptable defect where the Inspector considers repairs necessary. Such tests may be radiograph, ultrasonic, magnetic particle, or liquid penetrant and shall be at the Contractor's expense.IFA may direct, approve, or reject such tests.

Weld preparation shall be examined using magnetic particle or liquid penetrant methods in accordance with ASTM A781, S5. Repaired areas shall be retested using magnetic particle or liquid penetrant methods as directed or approved. At the IFA's option, large repairs may require heat treatment in accordance with ASTM A148 requirements. The acceptance of a repaired socket shall be at the discretion of IFA.

Only cast sockets designed for strand shall be supplied. The compatibility of the pin and anchor socket dimensions and structural steel dimensions shall be certified by both the socket manufacturer and steel fabricator and shall covered by type C certifications in accordance with 916.02. Shop drawings and design calculations shall be submitted for each type of anchor socket.

Holes for socket pins shall be line-bored to final dimensions.

Socket Installation

Sockets shall be attached to the strands in accordance with the procedures submitted to IFA prior to socketing.

Sockets shall be attached to the structural strand at 20 percent of the minimum breaking strength of each diameter strand. After being splayed in preparation for socketing, the wires of a strand shall be cleaned of grease and

other impurities by a carefully controlled process that will assure no harm is done to the wire zinc coating. After socketing, the strand wires shall be re-lubricated adjacent to the socket.

The socket basket of the socket shall be preheated to expel moisture and to prevent the molten zinc from congealing before it completely fills the narrow lower end of the basket. The strand will be rejected if the socketing procedure results in bare wires within the socket.

Zinc that complies with ASTM B6, High Grade, or better shall be furnished to attach the sockets to the strand. The socket shall be filled with molten zinc in one continuous operation. The molten zinc shall be placed at the lowest practical temperature, usually approximately 925°F but never exceeding 1000°F, to minimize the effect of heat on the strands. The zinc temperature at the time of pouring shall be recorded and submitted to IFA.

Socket and strand alignment, and that the lengths of the cable assemblies, shall be verified after socketing. A tabulation of shop-measured lengths of each assembly shall be submitted to IFA for use in erection. The ambient temperature in the shop at the time the final strand assembly lengths are determined shall be recorded.

Testing of Structural Strand and Sockets

One piece at least 100 inches long from each pre-stretched length of strand shall be cut and tested as specified in paragraph 9 of ASTM A586 to demonstrate the strength of the strand and sockets. The ends of test pieces with installed sockets shall be selected at random from those that are to be used in filling the order shall be used for testing. The material and method of socketing shall be the same for test and production pieces. The sockets shall be attached to the jaws of the testing machine in such a manner that the stresses in the socket will reproduce those expected when the socket is installed in the bridge.

The Contractor shall provide positive means to ensure that the strand does not twist after pre-stretching and that the upper and lower sockets are prevented from rotating with respect to each other.

The first six pieces shall be stressed, and any other as directed by IFA, to destruction in a suitable testing machine. All the pieces shall be tested to not less than the minimum specified breaking strength. If, after six or more tests of pre-stretched strands have been made, IFA finds that the strength and elasticity have sufficient uniformity, IFA may direct that the testing be reduced to two pieces, one from each end of each manufactured length of strand instead of one from each pre-stretched length. The sockets used for these tests shall not be used in the bridge.

All anchor sockets and socketed zinc connections shall be at least grade 105/85 and meet or exceed the breaking strength of the structural strand attached. Each socket to be installed as part of the structure shall be proof loaded to 55% of the breaking strength of the attached structural strand following attachment of the structural strand.

If a socket breaks during the strand testing specified above, two additional sockets attached to strand shall be selected and the test repeated. Testing shall continue until the socket reliability is satisfactory to IFA, at which point the lot will be accepted. If 10 percent or more of the sockets tested break at a load less than the specified minimum breaking strength, the

entire lot will be rejected and a new lot shall be furnished and tested.

Delivery to Job Site and Storage of New Cable Assemblies

The cable assemblies shall be inspected prior to shipping and again prior to installation. The assemblies shall be transported to the job site in a manner such that no permanent deformation of the strand occurs. Any cable assembly damaged by handling, transporting, or storing shall be replaced at Contractor's expense.

The new assemblies shall be stored under a roofed structure. Assemblies shall not be dragged at any time. Assemblies with damage to the zinc coating will be rejected. The assemblies shall be stored off the ground to keep strands dry.

Removal of Existing Hangers

The Contractor shall coordinate with IFA during the removal of the hanger cables. IFA shall be responsible to designate specific cables to be salvaged and provided to INDOT for material testing purposes. Salvaged cables shall be rolled and bound, placed on a pallet, and transported to the INDOT Falls City substation for future use. The Contractor will be responsible for the disposal of all other hanger cables.

Submittals

The following submittals are required in addition to those listed in the Construction Requirements for Field Verification, Temporary Jacking, and Fabriction and Testing.

The Contractor shall submit working drawings with supporting calculations in accordance with 105.02 for the temporary support system designed to support the floor beam during the hanger replacement process. The drawings shall include temporary jacks, materials, and appurtenances needed for the safe removal and replacement of the existing cables and associated hardware and load transfer to the hanger replacement cables.

The Contractor shall submit the names and qualifications of the professional engineers that will take responsibility for all aspects of the hanger replacement process. These engineers shall be registered in the state of Indiana, shall meet INDOT Prequalification category 9.3, Bridge Level 3 design qualification, and shall submit qualifying experience for cable structures approval prior to working on these aspects of the project.

The Contractor shall submit to IFA for approval of all details, calculations, and any required shop drawings, catalog cuts, materials, equipment, methods and procedures proposed for the manufacture and fabrication of the hangers and sockets, and the assembly, testing, and erection of the hangers all complete in place. All calculations and shop drawings shall be signed and sealed by a professional engineer registered in the State of Indiana.

The submittal shall include all material designations and certified test reports or certificates of conformance or compliance, furnished by the manufacturer's testing laboratory or independent testing agency, attesting that all materials meet the requirements specified.

The submittal shall also include the exact size of strand proposed for the

hangers, together with details for the construction of the hanger, giving the exact number and size of wires in each of the outer and inner layers, and their arrangement.

The dimensions relative to hanger lengths and strand elongations or that are otherwise dependent on the hanger modulus of elasticity, shall be adjusted if the actual modulus of elasticity, as determined by the Contractor after pre-stretching the strand, differs from the design assumptions. In that case, the proposed adjustments shall be submitted with calculations to IFA for approval.

Installation records shall be submitted to IFA. Records shall include survey records; date, time and ambient temperatures; cable forces; cable elongation measurements; deck loading conditions; and all other special notations. This record shall include the profile grade elevation of the deck along each cable anchor point immediately prior to and immediately after each hanger replacement operation.

ATTACHMENT 14-5

UNIQUE SPECIAL PROVISION

EMBEDDED GALVANIC ANODES

DESCRIPTION

This work shall consist of the installation of galvanic anodes directly to the existing reinforcing bars as a means of corrosion protection. The galvanic anodes shall be installed anywhere existing concrete is patched and the rebar is exposed as described herein.

This work will also include the replacement of any exposed bars which have less than 50% of their original cross-sectional area remaining. Any bars damaged by the contractor during concrete removal shall be replaced completely or lap bars supplied at the Contractor's expense.

MATERIALS

Reinforcing Steel bars shall be in accordance with 703.02

2.01 Embedded galvanic anodes shall be pre-manufactured and consist of zinc in compliance with ASTM B418-95a Type I cast around a pair of steel tie wires in compliance with bright annealed ASTM A82-97a and encased in a highly alkaline cementitious shell with a pH of 14 or greater. The cementitious shell shall contain no chlorides or other corrosive constituents as per ACI Guideline No. 222. Anodes shall be supplied with integral tie wires for tying to the reinforcing steel. Embedded galvanic anodes shall be:

Galvashield®XP or XP+ available from or approved equal
Vector Corrosion Technologies
417 Main Avenue
Fargo, ND 58103
701-280-9697

Galvanic anodes furnished under this specification shall be covered by a Type A Certification in accordance with 916.

2.02 Applications for equals shall include:

2.02.1 A highly alkaline cementitious shell with a pH of 14 or greater

2.02.2 Provide a minimum of 10 years service life (in similar environment)

2.02.3 Contain no corrosive constituents detrimental to reinforcing steel, e.g. chloride, bromine, etc.

2.02.4 Proven track record showing a minimum of three years satisfactory field performance

2.02.5 A minimum of three projects of similar size and application

2.02.6 Anodes shall be supplied with integral tie wires for tying to the reinforcing steel

2.02.7 Material acceptance and basis for use shall be in accordance with 2.0.1.

2.03 Repair mortars and concrete shall be Portland cement-based materials in accordance with 702.03 with suitable electrical

conductivity. Non-conductive repair materials and bonding agents such as epoxy, urethane, or magnesium phosphate shall not be permitted.

2.04 Deformed bars for reinforcement
Shall be hot-rolled steel in accordance with 703.02.
2.05 Deliver, store, and handle all materials
In accordance with manufacturer's instructions.

3.01 Concrete Removal
3.01.1 Remove loose or delaminated concrete.
3.01.2 Undercut all exposed reinforcing by removing concrete from the full circumference of the steel. The clearance between the concrete substrate and reinforcing steel shall be 1 inch.
3.01.3 Concrete removal shall continue along the reinforcing steel until there are no signs of concrete deterioration.

3.02 Cleaning and Repair of Reinforcing Steel
3.02.1 Clean exposed reinforcing steel of rust, mortar, etc. to provide sufficient electrical connection and mechanical bond.
3.02.2 If significant reduction in the cross section of the reinforcing steel has occurred (less than 50% of original cross-sectional area remains), lap, splice, or replace supplemental reinforcement in accordance with 703.06
3.02.3 Secure loose reinforcing steel by tying tightly to other bars with steel tie wire.

3.03 Edge and Surface Preparation of Concrete
3.03.1 Concrete patches shall be approximately square or rectangular in shape with squared corners.
3.03.2 Saw cut or vertically chip the patch boundary ½" deep or less if required to avoid cutting reinforcing steel.
3.03.3 Create a clean, sound substrate by removing bond inhibiting materials from the concrete substrate by abrasive blasting.

3.04 Galvanic Anode Installation
3.04.1 Galvanic anodes shall be installed along the perimeter of the repair or interface with spacing not to exceed 18 inches, and in accordance with the manufacturer’s recommendations.
3.04.2 Provide sufficient clearance between anodes and substrate to allow repair material to encase anode.
3.04.3 Secure the galvanic anodes as close as possible to the patch edge using the anode tie wires. The tie wires shall be wrapped around the cleaned reinforcing steel and twisted tight to allow little or no free movement.
3.04.3.1 If the anode is to be tied onto a single bar, or if less than 1 inch of concrete cover is expected, place anode beneath the bar and secure to clean reinforcing steel.
3.04.3.2 If sufficient concrete cover exists, the anode may be placed at the intersection between two bars and secured to each clean bar.
3.04.4 Electrical Continuity
3.04.4.1 Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm) with a multi-meter.
3.04.5 Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established with steel tie wire.

3.04.6 Electrical continuity is acceptable if the DC resistance measured with multi-meter is less than 1 ohm.

Attachment 14-6

TP Figures

Figure 1: Lateral Restraint with Broken Keeper (Bridge 056B00161N)

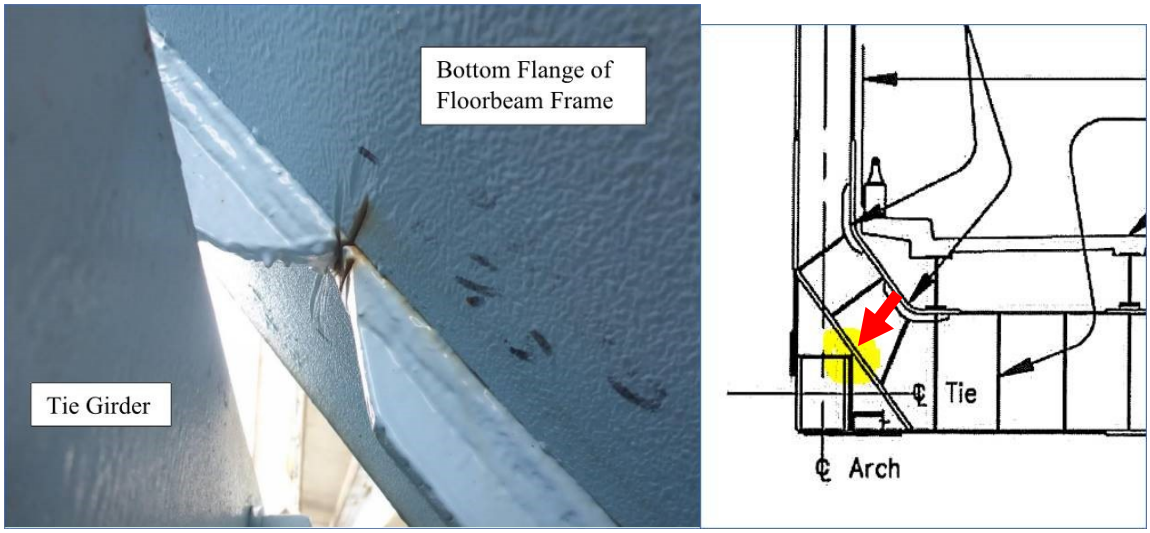


Figure 2: Representative Floorframe Notch and Schematic Cross-section Location (I64-123-04691 E)

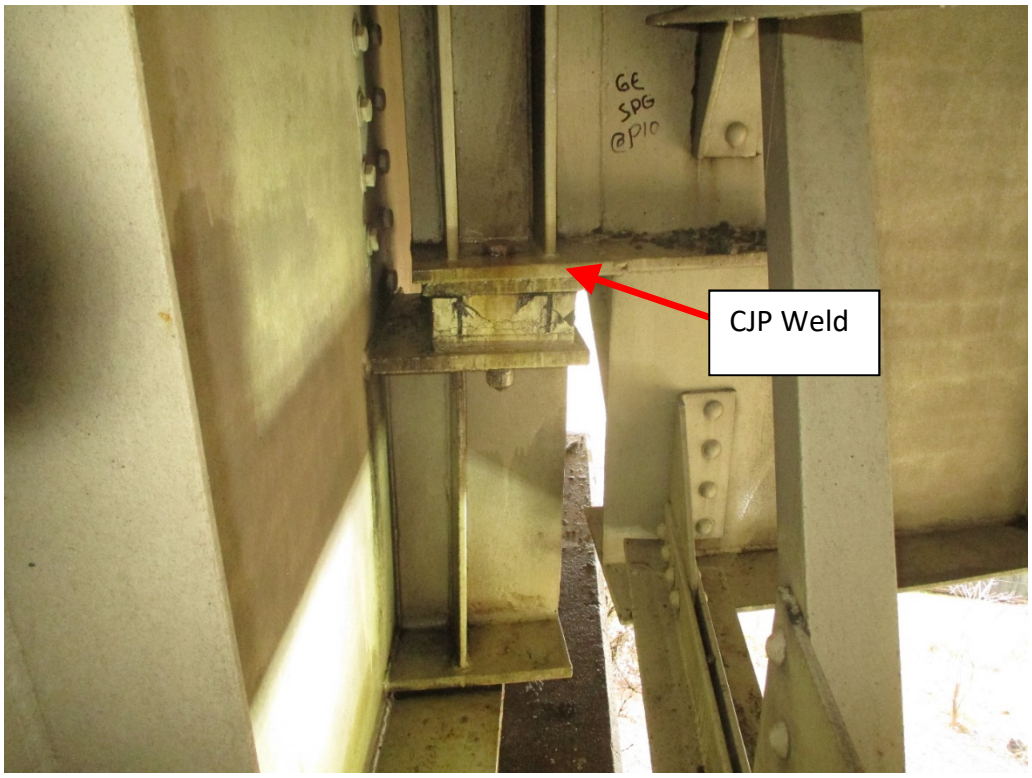


Figure 3: Representative girder end detail (I64-123-02294 DWBL)

Figure 4: Span G, Girder F, 12’ from Pier 10 Cross Girder: Looking up at 3” cut in bottom flange

Design Rating Vehicles

Design Load

Axle #	HS-20		H-20		AML		HL-93	
	weight	spacing	weight	spacing	weight	spacing	weight	spacing
1	8000	14’	8000	14’	24000	4’	8000	14’
2	32000	14’-30’	32000		24000		32000	14’-30’
3	32000						32000	
4								
5								
6								
7								
Pounds	72000		40000		48000		72000	
Tons	36		20		24		36	
Axles	3		2		2		3	
Length	28’-44’		14’		4’		28’-44’	
Lane Load	640 lbs/ft and 18,000 lbs for moment or 26,000 lbs for shear		640 lbs/ft and 18,000 lbs for moment or 26,000 lbs for shear				640 lbs/ft	

Legal Rating Vehicles

AASHTO SHV Loads

Axle #	SU4		SU5		SU6		SU7	
	weight	spacing	weight	spacing	weight	spacing	weight	spacing
1	12000	10’	12000	10’	11500	10’	11500	10’
2	8000	4’	8000	4’	8000	4’	8000	4’
3	17000	4’	8000	4’	8000	4’	8000	4’
4	17000		17000	4’	17000	4’	17000	4’
5			17000		17000	4’	17000	4’
6					8000		8000	4’
7							8000	
8								
Pounds	54000		62000		69500		77500	
Tons	27		31		34.75		38.75	
Axles	4		5		6		7	
Length	18’		22’		26’		30’	

KY Legal Loads

Axle #	KY Type 1		KY Type 2		KY Type 3		KY Type 4	
	weight	spacing	weight	spacing	weight	spacing	weight	spacing
1	8000	14’	7940	12’	13980	12’	9600	12’
2	32000		24380	4’	19840	4’	17600	4’
3			24380		19840	4’	17600	14’
4					19840		17600	4’
5							17600	
Pounds	40000		56700		73500		80000	
Tons	20		28.35		36.75		40	
Axles	2		3		4		5	
Length	14’		16’		20’		34’	

Emergency Vehicle Loads

Axle #	EV 2		EV 3	
	weight	spacing	weight	spacing
1	24000	15’	24000	15’
2	33500		31000	4’
3			31000	
Pounds	57500		86000	
Tons	28.75		43	
Axles	2		3	
Length	15’		19’	

Permit Rating Vehicles

Kentucky Permit Loads

Axle #	Superload A254		Superload B375		Superload C547			Permit D		Permit E		Permit F		Permit G		Permit H	
	weight	spacing	weight	spacing	weight	spacing	wheel gage	weight	spacing	weight	spacing	weight	spacing	weight	spacing	weight	spacing
1	14000	18’	15000	16’	15000	16’	normal distribution	20000	14	15000	14	15000	16	20000	17.42	20000	17.5
2	20000	4.5’	20000	4.5’	20000	4.5’	normal distribution	20000	4.5	24000	4.5	24000	4.5	20000	4.5	20000	4.5
3	20000	4.25’	20000	4.5’	20000	4.5’	normal distribution	20000	4.5	24000	40	24000	40	20000	4.5	20000	4.5
4	20000	18’	20000	14.25’	20000	21.25’	normal distribution	20000	40	20000	4.5	20000	4.5	20000	15.08	20000	7.083
5	20000	4.5’	20000	5’	35000	5.75’	2-lane distribution	20000	4.5	20000	4.5	20000	4.5	24000	5	37100	4.917
6	20000	4.5’	20000	5’	35000	16’	2-lane distribution	20000	4.5	20000	4.5	20000		24000	35.5	37100	4.917
7	20000	39’	20000	14’	35000	5.75’	2-lane distribution	20000	4.5	20000				20000	5	37100	41.67
8	20000	4.5’	20000	5’	35000	14’	2-lane distribution	20000						20000	5	37100	4.917
9	20000	4.5’	20000	5’	35000	5.75’	2-lane distribution							20000	15.08	37100	4.917
10	20000	14’	20000	63’	35000	50’	2-lane distribution							24000	5	37100	4.917
11	20000	4.5’	20000	5’	35000	5.75’	2-lane distribution							24000		37100	
12	20000	4.5’	20000	5’	35000	16’	2-lane distribution										
13	20000		20000	14’	35000	5.75’	2-lane distribution										
14			20000	5’	35000	14’	2-lane distribution										
15			20000	5’	35000	5.75’	2-lane distribution										
16			20000	14’	35000	13.5’	2-lane distribution										
17			20000	5’	12000	19.5’	normal distribution										
18			20000	5’	20000	4.5’	normal distribution										
19			20000		20000		normal distribution										
Pounds	254000		375000		547000			160000		143000		123000		236000		339700	
Tons	127		187.5		273.5			80		71.5		61.5		118		169.85	
Axles	13		19		19			8		7		6		11		11	
Length	124.75'		194.25'		228.25'			76.50'		72.00'		69.50'		112.08'		99.84'	

Attachment 15-1
Project Utility Summary

Project Design and Utility Summary

Reporting Period:

DES NO:
Project Description:
Utility Coordinator:
Oversight Agent:
Project Manager:

Contract NO:
Letting Date:
Ready for Contract Date:
Design Consultant:
Phone No:

Utility Coordinator	Designer (collaboration with Utility Coordinator as needed)													Utility Coordinator			Project Team Collaboration										
																	Environmental Impact		Right-of-Way Impact		Constructability Impact		Project Schedule Impact		Project Cost Impact		
Utility Name & Contact Person	Conflict ID	Drawing or Sheet No.	Utility Type	Material and Size	Description Of Design Conflict With Utility	Start Station	Start Offset	End Station	End Offset	Utility Investigation Level Needed	Designer's Justification To Impact The Utility	Design Around Alternative description*	Design Around Estimated Cost*	Utility Relocation Plan	Estimated Utility Relocation Cost	Utility Relocation Reimbursable	Design Around	Utility Relocation	Design Around	Utility Relocation	Design Around	Utility Relocation	Design Around	Utility Relocation	Design Around	Utility Relocation	Recommended Resolution

*Design around alternative and estimated construction cost level of detail should match the current plan development stage and level of known information of the conflict (i.e. initial assessment estimated costs should be similar to an engineering assessment estimation; SUE QL-A provided for Utility - higher level of known information, design alternative and estimate should be more refined.

ATTACHMENT 15-2

Utilities Work Plan Template

Date: Enter Date

Subject:

Utility Relocation Work Plan for:	Enter the Utility Name
Facility Type:	Enter Facility Type- gas, water, etc.

Section 1: General Information

A. INDOT/LPA Project Information

1.	DES NO.:	Enter the DES#
2.	Route Number:	Enter the Route Number
3.	Location:	Enter the Location Information
4.	Work Type:	Enter the Project Work Type
5.	Letting Date:	Enter the Letting Date
6.	Date Work Plan Needed	Enter the Date Work Plan Required
7.	Target Date for Utility to be out of conflict with INDOT Project	Enter Target Date
	Intermediate Phase	Enter Target Date
	Intermediate Phase	Enter Target Date

B. Utility Designated Contact – Information

1.	Designated Contact Name:	Enter Designated Contact Name
2.	Office telephone:	Enter Office Telephone
3.	Mobile telephone:	Enter Mobile Telephone
4.	Email address:	Enter Email Address
5.	Agency name	Enter Agency/Utility Name
6.	Address:	Enter Address
7.	City, State, Zip Code:	Enter City, State, Zip
8.	Construction Emergency Contact:	
	Name:	Enter Contact Name
	Number:	Enter Phone Number

C. By signing here, the Utility has determined to the best of their ability that they do not have facilities within the project area:

Signature of Utility Representative Print Name Date

Note: A signature by the utility representative at item "(C)" fulfills the requirement to complete the rest of this form and affirms their contact information above is correct

D. INDOT/LPA Utility Coordinator Contact Information

1.	Utility Coordinator Name:	Enter Coordinator Name
2.	Office Telephone:	Enter Office Telephone
3.	Mobile Telephone:	Enter Mobile Telephone
4.	Email Address:	Enter Email Address
5.	Agency Name:	Enter Agency Name
6.	Address:	Enter Address
7.	City, State, Zip Code	Enter City, State, Zip Code

Section 2: A narrative description of existing facilities within the project limits and any facility relocation that will be required. [IAC 13-3-3(c)]

A. Describe what types of existing active and inactive facilities are present.

B. Describe the location of existing active and inactive facilities.

C. Describe what will be done with existing active and inactive facilities.

D. Describe the details of the proposed new facilities.

E. Describe the proposed location of the new facilities.

F. By signing here, the Utility has determined to the best of their ability that they have facilities within the project area and the facilities are not in conflict with the project based upon the plans received on **<Enter Date Received Plans>**

Signature of Utility Representative Print Name Date

Note: A signature by the utility representative at item "(F)" fulfills the requirement to complete the rest of this form and affirms their contact information above is correct.

Section 3: A statement whether the facility relocation is or is not dependent on the acquisition of additional property interests with a description of that work. [IAC 13-3-3(c) (2) (B)]

Section 4: A statement whether the utility is or is not willing to allow the INDOT contractor to do the required work as part of the highway contract. [IAC 13-3-3(c) (3)]

Section 5: From the date the work plan is approved by both parties; please provide the Utility's pre-construction scheduling information. [IAC 13-3-3(c) (4), IAC 13-3-3(c) (5)]

A.	The expected lead time in calendar days to obtain required permits:	Enter Total Days
B.	The expected lead time in calendar days to obtain materials:	Enter Total Days
C.	The expected lead time in calendar days to schedule work crews:	Enter Total Days
D.	If the contractor is being selected by competitive bid what is the date of selection?	Enter Bid Date
E.	The expected lead time in calendar days to obtain new property interests:	Enter Days
F.	The earliest date when the utility could begin to implement the pre-construction activities of the work plan:	Enter Date
G.	The total number of calendar days for pre-construction activities: (accounting for concurrent activities)	Enter Total Days

Section 6: The Utility Construction Scheduling Information. [IAC 13-3-3(c) (4), IAC 13-3-3(c) (5)]

A. A statement whether the facility relocation is or is not dependent on work to be done by another utility with a description of that work. [IAC 13-3-3(c)(2)(A)(i)]

1. Utility A, with a description of the required work.

2. Utility B, with a description of the required work.

3. Utility C, with a description of the required work.

B. A statement whether the facility relocation is or is not dependent on work to be done by the department or the department's contractor with a description of that work. [IAC 13-3- 3(c)(2)(A)(ii)]

1. Work item A

2. Work item B

3. Work item C

C. How many calendar days after the events identified in Sec 6 A and B are completed can the utility begin construction: Enter Total Days

D. The number of calendar days to complete the relocation work: Enter Total Relocation Days

Section 7: A drawing of sufficient detail with station, offset, elevations, and scale to show the proposed location of the facility relocation, which takes precedence over the narrative description of the work, needs to be on INDOT Construction drawings. [IAC 13-3-3(c) (6)]. Plans must be attached to this Work Plan Document.

Section 8: For each work plan the utility shall include a cost estimate for the facility relocation. For reimbursable work the estimate will identify betterment and salvage which is not reimbursable. [IAC 13-3-3(d)]

Section 9: For work the utility is entitled to be compensated by the Department, the work plan shall include documentation of property interests and compensable land rights. [IAC 13-3-3(d)]

Section 10: The implementation of this approved work plan is dependent upon the issuance of: (a notice to proceed will be provided when items in Section 6 are accomplished)

Items Completed	Yes	Not Applicable
An executed reimbursement agreement with INDOT/LPA:	☐	☐
A relocation permit from INDOT/LPA:	☐	☐

(Note: Double-click on box in Yes or NA to mark it with an "X")

_____ _____

Signature of Utility Representative Date

_____

Utility Representative Name Printed

INDOT/LPA use only below this point ---------- INDOT/LPA use only below this point

ATTACHMENT 15-2
Utilities Work Plan Template

INDOT/LPA use only below this point ---------- INDOT/LPA use only below this point

The following sections are to be used by INDOT personnel to review the utility relocation work plan.

Section 11: The Department shall review the work plan to ensure that it: [IAC 13-3-3(e)]

Description	Yes	N/A	Utility Coordinator Initials
(1.a) is compatible with department permit requirements	☐	☐	
(1.b) is compatible with the project plans	☐	☐	
(1.c) is compatible with the construction schedule	☐	☐	
(1.d) is compatible with other utility relocation work plans	☐	☐	
(2.a) has reasonable relocation scheme	☐	☐	
(2.b) has a reasonable cost for compensable work	☐	☐	

(**Note**: Double-click on box under Yes or N/A to mark it with an "X")

Utility Coordinator Signature _____ Date _____

Utility Coordinator Name Printed _____

Section 12: Approved Work Plan. [IAC 13-3-3(f)]

I have reviewed the work plan and have been made aware of the schedule and budget.

Project Manager Signature (LPA Project – ERC Signature) _____ Date _____

Project Manager Name Printed (LPA Project – ERC Name Printed) _____

Attachment 15-3 Utility Adjustments

Type 1 Utility Adjustment

None are anticipated

Type 2 Utility Adjustment

None are anticipated

Type 3 Utility Adjustment

None are anticipated

Type 4 Utility Adjustment

None are anticipated

ATTACHMENT 16-1

RECURING SPECIAL PROVISION

RAILROAD INFORMATION

The State of Indiana Standard Specifications are revised as follows:

SECTION 103, LINE 562, DELETE AND INSERT AS FOLLOWS:

103.03 Blank Railroad Provision

This project requires work to be done on or in the vicinity of railroad property. Railroad Protective Liability Insurance shall be required. Unique insurance requirements for this contract are included in Section 107.09 and shall be complied with in addition to the requirements of Section 103.04.

SECTION 107.09, AFTER LINE 383, INSERT AS FOLLOWS:

(c) Railroad Information

All work on or in the vicinity of the railroad(s)' right-of way shall be subject to and governed by the provisions titled "PROTECTION OF RAILWAY INTEREST". The railroad information contained therein pertaining to rate of pay and additional charges applied to payment for persons performing flagging services, number of trains, and speed of trains, was furnished by the Railroad Company(s). This information shall be verified in order to determine costs for the contract.

PROTECTION OF RAILWAY INTEREST

Norfolk Southern Railway Company

1. AUTHORITY OF RAILROAD ENGINEER AND DEPARTMENT ENGINEER:
The authorized representative of the Railroad Company, hereinafter referred to as Railroad Engineer, shall have final authority in all matters affecting the safe maintenance of Railroad traffic of his Company including the adequacy of the foundations and structures supporting the Railroad tracks. For Public Projects impacting Norfolk Southern, the Public Projects Engineer will serve as the Railroad Engineer.

The authorized representative of the Department, hereinafter referred to as the Department Engineer, shall have authority over all other matters as prescribed herein and in the Project Specifications.

The Sponsor's Prime Contractor, hereinafter referred to as "Contractor" shall be responsible for completing any and all work in accordance with the terms prescribed herein and in the Project Specifications. These terms and conditions are subject to change without notice, from time to time in the sole discretion of the Railroad. Contractor must request from Railroad and follow the latest version of these provisions prior to commencing work.

2. NOTICE OF STARTING WORK:

A. Department's Prime contractor shall not commence any work on railroad rights-of-way until he has complied with the following conditions:

1. Signed and received a fully executed copy of the required Norfolk Southern Contractor Right of Entry Agreement.

2. Given the Railroad written notice in electronic format to the Railroad Engineer, with copy to the Department Engineer who has been designated to be in charge of the work, at least ten days in advance of the date he proposes to begin work on Railroad rights-of-way.

3. Obtained written approval from the Railroad of Railroad Protective Liability Insurance coverage as required by paragraph 14 herein. It should be noted that Railroad Company does not accept notation of Railroad Protective insurance on a certificate of liability insurance form or Binders as Railroad Company must have the full original countersigned policy. Further, please note that mere receipt of the policy is not the only issue but review for compliance. Due to the number of projects system-wide, it typically takes a minimum of 30-45 days for Railroad Company to review.

4. Obtained Railroad's Flagging Services as required by paragraph 7 herein.

5. Obtained written authorization from the Railroad to begin work on Railroad rights- of-way, such authorization to include an outline of specific conditions with which he must comply.

6. Furnished a schedule for all work within the Railroad rights-of-way as required by paragraph 7.B.1.

B. The Railroad's written authorization to proceed with the work shall include the names, addresses, and telephone numbers of the Railroad's representatives who are to be notified as hereinafter required. Where more than one representative is designated, the area of responsibility of each representative shall be specified.

3. INTERFERENCE WITH RAILROAD OPERATIONS:

A. The Contractor shall so arrange and conduct his work that there will be no interference with Railroad operations, including train, signal, telephone and telegraphic services, or damage to the property of the Railroad Company or to poles, wires, and other facilities of tenants on the rights-of-way of the Railroad Company. Whenever work is liable to affect the operations or safety of trains, the method of doing such work shall first be submitted to the Railroad Engineer for approval, but such approval shall not relieve the Contractor from liability. Any work to be performed by the Contractor which requires flagging service or inspection service shall be deferred by the Contractor until the flagging service or inspection service required by the Railroad is available at the job site.

B. Whenever work within Railroad rights-of-way is of such a nature that impediment to Railroad operations such as use of runaround tracks or necessity for reduced speed is unavoidable, the Contractor shall schedule and conduct his operations so that such impediment is reduced to the absolute minimum.

C. Should conditions arising from, or in connection with the work, require that immediate and unusual provisions be made to protect operations and property of the Railroad, the Contractor shall make such provisions. If in the judgment of the Railroad Engineer, or in his absence, the Railroad's Division Engineer, such provisions is insufficient, either may require or provide such provisions as he deems necessary. In any event, such unusual provisions shall be at the Contractor's expense and without cost to the Railroad or the Department.

D. "One Call" Services do not locate buried railroad utilities. The contractor shall contact the railroad's representative 2 days in advance of work at those places where excavation, pile driving, or heavy loads may damage railroad underground facilities. Upon request from the contractor or agency, railroad forces will locate and paint mark or flag railroad underground facilities. The contractor shall avoid excavation or other disturbances of these facilities. If disturbance or excavation is required near a buried railroad facility, the contractor shall coordinate with the railroad to have the facility potholed manually with careful hand excavation. The facility shall be protected by the contractor during the course of the disturbance under the supervision and direction of the railroad representative.

4. TRACK CLEARANCES:

A. The minimum track clearances to be maintained by the Contractor during construction are shown on the Project Plans. If temporary clearances are not shown on the project plans, the following criteria shall govern the use of falsework and formwork above or adjacent to operated tracks.

a. A minimum vertical clearance of 22'-0" above top of highest rail shall be maintained at all times.

b. A minimum horizontal clearance of 13'-0" from centerline of tangent track or 14'-0" from centerline of curved track shall be maintained at all times. Additional horizontal clearance may be required in special cases to be safe for operating conditions. This additional clearance will be as determined by the Chief Engineer Bridges & Structures

c. All proposed temporary clearances which are less than those listed above must be submitted to the Chief Engineer Bridges & Structures for approval prior to construction and must also be authorized by the regulatory body of the State if less than the legally prescribed clearances.

d. The temporary clearance requirements noted above shall also apply to all other physical obstructions including, but not limited to: stockpiled materials, parked equipment, placement or driving of piles, and bracing or other construction supports.

B. Before undertaking any work within Railroad right-of-way, and before placing any obstruction over any track, the Contractor shall:

a. Notify the Railroad's representative at least 72 hours in advance of the work.

b. Receive assurance from the Railroad's representative that arrangements have been made for flagging service as may be necessary.

c. Receive permission from the Railroad's representative to proceed with the work.

d. Ascertain that the Department Engineer has received copies of notice to the Railroad and of the Railroad's response thereto.

5. CONSTRUCTION PROCEDURES:

A. General:

1. Construction work and operations by the Contractor on Railroad property shall be:

i. Subject to the inspection and approval of the Railroad or their designated Construction Engineering Representative.

ii. In accord with the Railroad's written outline of specific conditions.

iii. In accord with the Railroad's general rules, regulations and requirements including those relating to safety, fall protection and personal protective equipment.

iv. In accord with these Special Provisions.

2. Submittal Requirements:

i. The contractor shall submit all construction related correspondence and submittals electronically to the Railroad Engineer.

ii. The contractor shall allow for 30 days for the Railroad's review and response.

iii. All work in the vicinity of the Railroad's property that has the potential to affect the Railroad's train operations or disturb the Railroad's Property must be submitted and approved by the Railroad prior to work being performed.

iv. All submittals and calculations must be signed and sealed by a registered engineer licensed in the state of the project work.

v. All submittals shall first be approved by the Department Engineer and the Railroad Engineer, but such approval shall not relieve the Contractor from liability.

vi. For all construction projects, the following submittals, but not limited to those listed below, shall be provided for review and approval when applicable:

i. General Means and Methods

ii. Roadway Protection

iii. Construction Excavation & Shoring

iv. Pipe, Culvert, & Tunnel Installations

v. Demolition Procedure

vi. Erection & Hoisting Procedure

vii. Debris Shielding or Containment

viii. Blasting

ix. Formwork for the bridge deck, diaphragms, overhang brackets, and protective platforms

x. Bent Cap Falsework. A lift plan will be required if the contractor want to move the falsework over the tracks.

vii. For Undergrade Bridges (Bridges carrying the Railroad) the following submittals in addition to those listed above shall be provided for review and approval:

i. Shop Drawings

ii. Bearing Shop Drawings and Material Certifications

iii. Concrete Mix Design

iv. Structural Steel, Rebar, and/or Strand Certifications

v. 28 day Cylinder Test for Concrete Strength

vi. Waterproofing Material Certification

vii. Test Reports for Fracture Critical Members

viii. Foundation Construction Reports

Fabrication may not begin until the Railroad has approved the required shop drawings.

viii. The Contractor shall include in all submissions a detailed narrative indicating the progression of work with the anticipated timeframe to complete each task. Work will not be permitted to commence until the Contractor has provided the Railroad with a satisfactory plan that the project will be undertaken without scheduling, performance or safety related issues. Submission shall also provide a listing of the anticipated equipment to be used, the location of all equipment to be used and insure a contingency plan of action is in place should a primary piece of equipment malfunction.

B. Roadway Protection

a. The Contractor shall submit the proposed roadway protection system detailing the specific filter fabric and anchorage system to be used during all construction activities.

b. The roadway protection is to extend 25’ beyond the proposed limit of work, be installed at the start of the project and be continuously maintained to prevent all contaminants from entering the ballast section of all tracks for the entire duration of the project.

C. Excavation:

a. The subgrade of an operated track shall be maintained with edge of berm at least 10’-0” from centerline of track and not more than 24- inches below top of rail. Contractor will not be required to make existing section meet this specification if substandard, in which case existing section will be maintained.

b. Additionally, the Railroad will require the installation of an OSHA approved handrail and orange construction safety fencing for all excavations of the Railroad right-of-way.

D. Excavation for Structures and Shoring Protection:

a. The Contractor will be required to take special precaution and care in connection with excavating and shoring pits, and in driving piles or sheeting for footings adjacent to tracks to provide adequate lateral support for the tracks and the loads which they carry, without disturbance of track alignment and surface, and to avoid obstructing track clearances with working equipment, tools or other material.

b. All plans and calculations for shoring shall be prepared and signed by a Registered Professional Engineer, licensed in the state of the proposed project, in accordance with Norfolk Overhead Grade Separation Design Criteria, subsection H.1.6.E- Construction Excavation(Refer to Norfolk Southern’s Public Projects Manual). The Registered Professional Engineer will be responsible for the accuracy for all controlling dimensions as well as the selection of soil design values which will accurately reflect the actual field conditions.

c. The contractor shall provide a detailed installation and removal plan of the shoring components. Any component that will be installed via the use of a crane or any other lifting device shall be subject to the guidelines outlined in section 5.G.

d. The contractor shall be required to survey the track(s) and railroad embankment and provide a cross section of the proposed excavation in relation to the tracks.

e. Calculations for the proposed shoring should include deflection calculations. The maximum deflection for excavations within 18'-0" of the centerline of the nearest track shall be 3/8". For all other cases, the max deflection shall not exceed ½".

f. Additionally, the Railroad will require the installation of an OSHA approved handrail and orange construction safety fencing for all excavations of the Railroad right-of-way.

g. The front face of shoring located to the closest NS track for all shoring set-ups located in Zone 2 as shown on NS Typical Drawing No. 4 - Shoring Requirements (Appendix I) shall remain in place and be cut off 2'-0" below the final ground elevation. The remaining shoring in Zone 2 and all shoring in Zone 1 may be removed and all voids must be backfilled with flowable fill.

E. Pipe, Culvert, & Tunnel Installations

Pipe, Culvert, & Tunnel Installations shall be in accordance with the appropriate Norfolk Southern Design Specification as noted below:

i. For Open Cut Method refer to Norfolk Southern Public Projects Manual Appendix H.4.6.
ii. For Jack and Bore Method refer to Norfolk Southern Public Projects Manual Appendix H.4.7.
iii. For Tunneling Method refer to Norfolk Southern Public Projects Manual Appendix H.4.8.

The installation methods provided are for pipes carrying storm water or open flow run-off. All other closed pipeline systems shall be installed in accordance Norfolk Southern's Pipe and Wire Program and the NSCE-8.

F. Demolition Procedure

1. General

i. Demolition plans are required for all spans over the track(s), for all spans adjacent to the track(s), if located on (or partially on) Railroad right-of-way; and in all situations where cranes will be situated on, over, or adjacent to Railroad right-of-way and within a distance of boom length plus 15'-0" from the centerline of track.

ii. Railroad tracks and other railroad property must be protected from damage during the procedure.

iii. A pre-demolition meeting shall be conducted with the Department, the Railroad Engineer or their representative, and the key contractor personnel prior to the start of the demolition procedure.

iv. The Railroad Engineer or his designated representative must be present at the site during the entire demolition procedure period.

v. Existing, obsolete, bridge piers shall be removed to a sufficient depth below grade to enable restoration of the existing/proposed track ditch, but in no case less than 2'-0" below final grade.

2. Submittal Requirements

i. In addition to the submittal requirements outlined in Section 5.A.2, the contractor shall submit the following for approval by the Railroad Engineer:

a. A plan showing the location of cranes, horizontally and vertically, operating radii, with delivery or disposal locations shown. The location of all tracks and other railroad facilities as well as all obstructions such as wire lines, poles, adjacent structures, etc. must also be shown.

b. Rating sheets showing cranes or lifting devices to be adequate for 150% of the actual weight of the pick, including all rigging components. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted. Safety factors that may have been "built-in" to the crane charts are not to be considered when determining the 150% factor of safety.

c. Plans and computations showing the weight of the pick must be submitted. Calculations shall be made from plans of the existing structure showing complete and sufficient details with supporting data for the demolition the structure. If plans do not exist, lifting weights must be calculated from field measurements. The field measurements are to be made under the supervision of the Registered Professional Engineer submitting the procedure and calculations.

d. The contractor shall provide a sketch of all rigging components from the crane's hook block to the beam. Catalog cuts or information sheets of all rigging components with their lifting capacities shall be provided. All rigging must be adequate for 150% of the actual weight of the pick. Safety factors that may have been "built-in" to the rating charts are not to be considered when determining the 150% factor of safety. All rigging components shall be clearly identified and tagged with their rated lifting capacities. The position of the rigging in the field shall not differ from what is shown on the final plan without prior review from the Department and the Railroad.

e. A complete demolition procedure, including the order of lifts, time required for each lift, and any repositioning or re-hitching of the crane or cranes.

f. Design and supporting calculations for the temporary support of components, including but not limited to the stability of the superstructure during the temporary condition, temporary girder tie- downs and falsework.

3. Overhead Demolition Debris Shield

i. The demolition debris shield shall be installed prior to the demolition of the bridge deck or other relevant portions of the superstructure over the track area to catch all falling debris.

ii. The demolition debris shield shall provide a minimum vertical clearance as specified in Section 4.A.1 or maintain the existing vertical clearance if the existing clearance is less than that specified in Section 4.A.1.

iii. The Contractor shall include the demolition debris shield installation/removal means and methods as part of the proposed Demolition procedure submission.

iv. The contractor shall submit the demolition debris shield design and supporting calculations for approval by the Railroad Engineer

v. The demolition debris shield shall have a minimum design load of 50 pounds per square foot plus the weight of the equipment, debris, personnel, and other loads to be carried.

vi. The Contractor shall include the proposed bridge deck removal procedure in its demolition means and methods and shall verify that the size and quantity of the demolition debris generated by the procedure does not exceed the shield design loads.

vii. The contractor shall clean the demolition debris shield daily or more frequently as dictated either by the approved design parameters or as directed by the Railroad Engineer.

4. Vertical Demolition Debris Shield

i. A vertical demolition debris shield may be required for substructure removals in close proximity to the Railroad's track and other facilities, as determined by the Railroad Engineer.

G. Erection & Hoisting Procedures

1. General

i. Erection plans are required for all spans over the track(s), for all spans adjacent to the track(s), if located on (or partially on) Railroad right-of-way; and in all situations where cranes will be situated on, over, or adjacent to Railroad right- of-way and within a distance of boom length plus 15'-0" from the centerline of track.

ii. Railroad tracks and other railroad property must be protected from damage during the erection procedure.

iii. A pre-erection meeting shall be conducted with the Department, the Railroad Engineer or their representative, and the key contractor personnel prior to the start of the erection procedure.

iv. The Railroad Engineer or his designated representative must be present at the site during the entire erection procedure period.

v. For field splices located over Railroad property, a minimum of 50% of the holes for each connection shall be filled with bolts or pins prior to releasing the crane. A minimum of 50% of the holes filled shall be filled with bolts. All bolts must be appropriately tightened. Any changes to previously approved field splice locations must be submitted to the Railroad for review and approval. Refer to Norfolk Southern's Overhead Grade Separation Design Criteria for additional splice details (Norfolk Southern Public Projects Manual Appendix H.1, Section 4.A.3.).

2. Submittal Requirements

i. In addition the submittal requirements outlined in Section 5.A.2, the contractor shall submit the following for approval by the Railroad Engineer:

a. As-built beam seat elevations – All as-built bridge seats and top of rail elevations shall be furnished to the Railroad Engineer for review and verification at least 30 days in advance of the erection, to ensure that minimum vertical clearances as approved in the plans will be achieved.

b. A plan showing the location of cranes, horizontally and vertically, operating radii, with delivery or staging locations shown. The location of all tracks and other railroad facilities as well as all obstructions such as wire lines, poles, adjacent structures, etc. must also be shown.

c. Rating sheets showing cranes or lifting devices to be adequate for 150% of the actual weight of the pick, including all rigging components. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted. Safety factors that may have been "built-in" to the crane charts are not to be considered when determining the 150% factor of safety.

d. Plans and computations showing the weight of the pick must be submitted. Calculations shall be made from plans of the proposed structure showing complete and sufficient details with supporting data for the erection of the structure. If plans do not exist, lifting weights must be calculated from field measurements. The field measurements are to be made under the supervision of the Registered Professional Engineer submitting the procedure and calculations.

i. The contractor shall provide a sketch of all rigging components from the crane's hook block to the beam. Catalog cuts or information sheets of all rigging components with their lifting capacities shall be provided. All rigging must be adequate for 150% of the actual weight of the pick. Safety factors that may have been "built-in" to the rating charts are not to be considered when determining the 150% factor of safety. All rigging components shall be clearly identified and tagged with their rated lifting capacities. The position of the rigging in the field shall not differ from what is shown on the final plan without prior review from the Department and the Railroad.

e. A complete erection procedure, including the order of lifts, time required for each lift, and any repositioning or re-hitching of the crane or cranes.

f. Design and supporting calculations for the temporary support of components, including but not limited to temporary girder tie-downs and falsework.

H. Blasting:

1. The Contractor shall obtain advance approval of the Railroad Engineer and the Department Engineer for use of explosives on or adjacent to Railroad property. The request for permission to use explosives shall include a detailed blasting plan. If permission for use of explosives is granted, the Contractor will be required to comply with the following:

i. Blasting shall be done with light charges under the direct supervision of a responsible officer or employee of the Contractor and a licensed blaster.

ii. Electric detonating fuses shall not be used because of the possibility of premature explosions resulting from operation of two-way radios.

iii. No blasting shall be done without the presence of the Railroad Engineer or his authorized representative. At least 72 hours advance notice to the person designated in the Railroad's notice of authorization to proceed (see paragraph 5.E.2.B) will be required to arrange for the presence of an authorized Railroad representative and such flagging as the Railroad may require.

iv. Have at the job site adequate equipment, labor and materials and allow sufficient time to clean up debris resulting from the blasting without delay to trains, as well as correcting at his expense any track misalignment or other damage to Railroad property resulting from the blasting as directed by the Railway's authorized representative. If his actions result in delay of trains, the Contractor shall bear the entire cost thereof.

v. The blasting contractor shall have a copy of the approved blasting plan on hand while on the site.

vi. Explosive materials or loaded holes shall not be left unattended at the blast site.

vii. A seismograph shall be placed on the track shoulder adjacent to each blast which will govern the peak particle velocity of two inches per second. Measurement shall also be taken on the ground adjacent to structures as designated by a qualified and independent blasting consultant. The Railroad reserves the option to direct the placement of additional seismographs at structures or other locations of concern, without regard to scaled distance.

viii. After each blast, the blasting contractor shall provide a copy of their drill log and blast report, which includes number of holes, depth of holes, number of decks, type and pounds of explosives used per deck.

ix. The Railroad may require top of rail elevations and track centers taken before, during and after the blasting and excavation operation to check for any track misalignment resulting from the Contractor's activities.

2. The Railroad representative will:

i. Determine approximate location of trains and advise the Contractor the appropriate amount of time available for the blasting operation and clean up.

ii. Have the authority to order discontinuance of blasting if, in his opinion, blasting is too hazardous or is not in accord with these special provisions.

3. The Contractor must hire, at no expense to the Railroad, a qualified and independent blasting consultant to oversee the use of explosives. The blasting consultant will:

i. Review the Contractor's proposed drilling and loading patterns, and with the blasting consultant's personnel and instruments, monitor the blasting operations.

ii. Confirm that the minimum amounts of explosives are used to remove the rock.

iii. Be empowered to intercede if he concludes that the Contractor's blasting operations are endangering the Railway.

iv. Submit a letter acknowledging that he has been engaged to oversee the entire blasting operation and that he approves of the blasting plan.

v. Furnish copies of all vibration readings to the Railroad representative immediately after each blast. The representative will sign and date the seismograph tapes after each shot to verify the readings are for that specific shot.

vi. Advise the Railroad representative as to the safety of the operation and notify him of any modifications to the blasting operation as the work progresses.

4. The request for permission to use explosives on the Railroad's Right-of-Way shall include a blasting proposal providing the following details:

   i. A drawing which shows the proposed blasting area, location of nearest hole and distance to Railway structures, all with reference to the centerline of track.

   ii. Hole diameter.

   iii. Hole spacing and pattern.

   iv. Maximum depth of hole.

   v. Maximum number of decks per hole.

   vi. Maximum pounds of explosives per hole.

   vii. Maximum pounds of explosives per delay.

   viii. Maximum number of holes per detonation.

   ix. Type of detonator and explosives to be used. (Electronic detonating devices will not be permitted). Diameter of explosives if different from the hole diameter.

   x. Approximate dates and time of day when the explosives are to be detonated.

   xi. Type of flyrock protection.

   xii. Type and patterns of audible warning and all clear signals to be used before and after each blast.

   xiii. A copy of the blasting license and qualifications of the person directly in charge of the blasting operation, including their name, address and telephone number.

   xiv. A letter from the blasting consultant acknowledging that he has been engaged to oversee the entire blasting operation and that he approves of the blasting plan.

   xv. In addition to the insurance requirements outlined in Paragraph 14, a certificate of insurance from the Contractor's insurer stating the amount of coverage for XCU (Explosive Collapse and Underground Hazard) insurance and that XCU Insurance is in force for this project.

   xvi. A copy of the borings and Geotechnical information or report.

I. Track Monitoring

1. At the direction of the Railroad Engineer, any activity that has the potential to disturb the Railroad track structure may require the contractor to submit a detailed track monitoring program for approval by the Railroad Engineer.

2. The program shall specify the survey locations, the distance between the location points, and frequency of monitoring before, during, and after construction. Railroad reserves the right to modify the survey locations and monitoring frequency as necessary during the project.

3. The survey data shall be collected in accordance with the approved frequency and immediately furnished to the Railroad Engineer for analysis.

4. If any movement has occurred as determined by the Railroad Engineer, the Railroad will be immediately notified. Railroad, at its sole discretion, shall have the right to immediately require all contractor operations to be ceased and determine what corrective action is required. Any corrective action required by the Railroad or performed by the Railroad including the monitoring of corrective action of the contractor will be at project expense.

J. Maintenance of Railroad Facilities:

1. The Contractor will be required to maintain all ditches and drainage structures free of silt or other obstructions which may result from his operations and provide and maintain any erosion control measures as required. The Contractor will promptly repair eroded areas within Railroad rights-of-way and repair any other damage to the property of the Railroad or its tenants.

2. If, in the course of construction, it may be necessary to block a ditch, pipe or other drainage facility, temporary pipes, ditches or other drainage facilities shall be installed to maintain adequate drainage, as approved by NS. Upon completion of the work, the temporary facilities shall be removed and the permanent facilities restored.

3. All such maintenance and repair of damages due to the Contractor's operations shall be done at the Contractor's expense.

K. Storage of Materials and Equipment:

1. Materials and equipment shall not be stored where they will interfere with Railroad operations, nor on the rights-of-way of the Railroad Company without first having obtained permission from the Railroad Engineer, and such permission will be with the understanding that the Railroad Company will not be liable for damage to such material and equipment from any cause and that the Railroad Engineer may move or require the Contractor to move, at the Contractor's expense, such material and equipment.

2. All grading or construction machinery that is left parked near the track unattended by a watchman shall be effectively immobilized so that it cannot be moved by unauthorized persons. The Contractor shall protect, defend, indemnify and save Railroad, and any associated, controlled or affiliated corporation, harmless from and against all losses, costs, expenses, claim or liability for loss or damage to property or the loss of life or personal injury, arising out of or incident to the Contractor's failure to immobilize grading or construction machinery.

L. Cleanup:

1. Upon completion of the work, the Contractor shall remove from within the limits of the Railroad rights-of-way, all machinery, equipment, surplus materials, falsework, rubbish or temporary buildings of the Contractor, and leave said rights-of-way in a neat condition satisfactory to the Chief Engineer of the Railroad or his authorized representative.

6. DAMAGES:

A. The Contractor shall assume all liability for any and all damages to his work, employees, servants, equipment and materials caused by Railroad traffic.

B. Any cost incurred by the Railroad for repairing damages to its property or to property of its tenants, caused by or resulting from the operations of the Contractor, shall be paid directly to the Railroad by the Contractor.

7. FLAGGING SERVICES:

A. Requirements:

1. Flagging services will not be provided until the contractor's insurance has been reviewed & approved by the Railroad.

2. Under the terms of the agreement between the Department and the Railroad, the Railroad has sole authority to determine the need for flagging required to protect its operations. In general, the requirements of such services will be whenever the Contractor's personnel or equipment are or are likely to be, working on the Railroad's right-of-way, or across, over, adjacent to, or under a track, or when such work has disturbed or is likely to disturb a railroad structure or the railroad roadbed or surface and alignment of any track to such extent that the movement of trains must be controlled by flagging.

3. Normally, the Railroad will assign one flagman to a project; but in some cases, more than one may be necessary, such as yard limits where three (3) flagmen may be required. However, if the Contractor works within distances that violate instructions given by the Railroad's authorized representative or performs work that has not been scheduled with the Railroad's authorized representative, a flagman or flagmen may be required full time until the project has been completed.

4. For Projects exceeding 30 days of construction, Contractor shall provide the flagmen a small work area with a desk/counter and chair within the field/site trailer, including the use of bathroom facilities, where the flagman can check in/out with the Project, as well as to the flagman's home terminal. The work area should provide access to two (2) electrical outlets for recharging radio(s), and a laptop computer; and have the ability to print off needed documentation and orders as needed at the field/site trailer. This should aid in maximizing the flagman's time and efficiency on the Project.

B. Scheduling and Notification:

1. The Contractor's work requiring railroad flagging should be scheduled to limit the presence of a flagman at the site to a maximum of 50 hours per week. The Contractor shall receive Railroad approval of work schedules requiring a flagman's presence in excess of 40 hours per week.

2. Not later than the time that approval is initially requested to begin work on Railroad right-of-way, Contractor shall furnish to the Railroad and the Department a schedule for all work required to complete the portion of the project within Railroad right-of-way and arrange for a job site meeting between the Contractor, the Department, and the Railroad's authorized representative. Flagman or Flagmen may not be provided until the job site meeting has been conducted and the Contractor's work scheduled.

3. The Contractor will be required to give the Railroad representative at least 10 working days of advance written notice of intent to begin work within Railroad right-of- way in accordance with this special provision. Once begun, when such work is then suspended at any time, or for any reason, the Contractor will be required to give the Railroad representative at least 3 working days of advance notice before resuming work on Railroad right-of-way. Such notices shall include sufficient details of the proposed work to enable the Railroad representative to determine if flagging will be required. If such notice is in writing, the Contractor shall furnish the Engineer a copy; if notice is given verbally, it shall be confirmed in writing with copy to the Engineer. If flagging is required, no work shall be undertaken until the flagman, or flagmen are present at the job site. It may take up to 30 days to obtain flagging initially from the Railroad. When flagging begins, the flagman is usually assigned by the Railroad to work at the project site on a continual basis until no longer needed and cannot be called for on a spot basis. If flagging becomes unnecessary and is suspended, it may take up to 30 days to again obtain from the Railroad. Due to Railroad labor agreements, it is necessary to give 5 working days notice before flagging service may be discontinued and responsibility for payment stopped.

4. If, after the flagman is assigned to the project site, an emergency arises that requires the flagman's presence elsewhere, then the Contractor shall delay work on Railroad right-of-way until such time as the flagman is again available. Any additional costs resulting from such delay shall be borne by the Contractor and not the Department or Railroad.

C. Payment:

1. The Department will be responsible for paying the Railroad directly for any and all costs of flagging which may be required to accomplish the construction.

2. The estimated cost of flagging is current rate per day based on a 10-hour work day. This cost includes the base pay for the flagman, overhead, and includes a per diem charge for travel expenses, meals and lodging. The charge to the Department by the Railroad will be the actual cost based on the rate of pay for the Railroad's employees who are available for flagging service at the time the service is required.

3. Work by a flagman in excess of 8 hours per day or 40 hours per week, but not more than 12 hours a day will result in overtime pay at 1 and 1/2 times the appropriate rate. Work by a flagman in excess of 12 hours per day will result in overtime at 2 times the appropriate rate. If work is performed on a holiday, the flagging rate is 2 and 1/2 times the normal rate.

4. Railroad work involved in preparing and handling bills will also be charged to the Department. Charges to the Department by the Railroad shall be in accordance with applicable provisions of Subchapter B, Part 140, Subpart I and Subchapter G, Part 646, Subpart B of the Federal-Aid Policy Guide issued by the Federal Highway Administration on December 9, 1991, including all current amendments. Flagging costs are subject to change. The above estimates of flagging costs are provided for information only and are not binding in any way.

D. Verification:

1. Railroad's flagman will electronically enter flagging time via Railroad's electronic billing system. Any complaints concerning flagging must be resolved in a timely manner. If the need for flagging is questioned, please contact Railroad's System Engineer – Public Improvements. All verbal complaints will be confirmed in writing by the Contractor within 5 working days with a copy to the Department's Engineer. Address all written correspondence electronically to Railroad's System Engineer – Public Improvements.

2. The Railroad flagman assigned to the project will be responsible for notifying the Department Engineer upon arrival at the job site on the first day (or as soon thereafter as possible) that flagging services begin and on the last day that he performs such services for each separate period that services are provided. The Department Engineer will document such notification in the project records. When requested, the Department Engineer will also sign the flagman's diary showing daily time spent and activity at the project site.

8. HAUL ACROSS RAILROAD:

A. Where the plans show or imply that materials of any nature must be hauled across a Railroad, unless the plans clearly show that the Department has included arrangements for such haul in its agreement with the Railroad, the Contractor will be required to make all necessary arrangements with the Railroad regarding means of transporting such materials across the Railroad. The Contractor or Agency will be required to bear all costs incidental to such crossings whether services are performed by his own forces or by Railroad personnel.

B. No crossing may be established for use of the Contractor for transporting materials or equipment across the tracks of the Railroad Company unless specific authority for its installation, maintenance, necessary watching and flagging thereof and removal, until a temporary private crossing agreement has been executed between the Contractor and Railroad. The approval process for an agreement normally takes 90-days.

9. WORK FOR THE BENEFIT OF THE CONTRACTOR:

A. All temporary or permanent changes in wire lines or other facilities which are considered necessary to the project are shown on the plans; included in the force account agreement between the Department and the Railroad or will be covered by appropriate revisions to same which will be initiated and approved by the Department and/or the Railroad.

B. Should the Contractor desire any changes in addition to the above, then he shall make separate arrangements with the Railroad for same to be accomplished at the Contractor's expense.

10. COOPERATION AND DELAYS:

A. It shall be the Contractor's responsibility to arrange a schedule with the Railroad for accomplishing stage construction involving work by the Railroad or tenants of the Railroad. In arranging his schedule he shall ascertain, from the Railroad, the lead time required for assembling crews and materials and shall make due allowance therefore.

B. No charge or claim of the Contractor against either the Department or the Railroad Company will be allowed for hindrance or delay on account of railway traffic; any work done by the Railway Company or other delay incident to or necessary for safe maintenance of railway traffic or for any delays due to compliance with these special provisions.

11. TRAINMAN'S WALKWAYS:

A. Along the outer side of each exterior track of multiple operated track, and on each side of single operated track, an unobstructed continuous space suitable for trainman's use in walking along trains, extending to a line not less than 10 feet from centerline of track, shall be maintained. Any temporary impediments to walkways and track drainage encroachments or obstructions allowed during work hours while Railway's protective service is provided shall be removed before the close of each work day. If there is any excavation near the walkway, a handrail, with 10'-0" minimum clearance from centerline of track, shall be placed and must conform to AREMA and/or FRA standards.

12. GUIDELINES FOR PERSONNEL ON RAILROAD RIGHT-OF-WAY:

A. The Contractor and/or the Agency's personnel authorized to perform work on Norfolk Southern's property as specified in Section 2 above are not required to complete Norfolk Southern Roadway Worker Protection Training; However the Contractor and the Agency's personnel must be familiar with Norfolk Southern's standard operating rules and guidelines, should conduct themselves accordingly, and may be removed from the property for failure to follow these guidelines.

B. All persons shall wear hard hats. Appropriate eye and hearing protection must be used. Working in shorts is prohibited. Shirts must cover shoulders, back and abdomen. Working in tennis or jogging shoes, sandals, boots with high heels, cowboy and other slip-on type boots is prohibited. Hard-sole, lace-up footwear, zippered boots or boots cinched up with straps which fit snugly about the ankle are adequate. Wearing of safety boots is strongly recommended. In the vicinity of at-grade crossings, it is strongly recommended that reflective vests be worn.

C. No one is allowed within 25’ of the centerline of track without specific authorization from the flagman.

D. All persons working near track while train is passing are to lookout for dragging bands, chains and protruding or shifted cargo.

E. No one is allowed to cross tracks without specific authorization from the flagman.

F. All welders and cutting torches working within 25’ of track must stop when train is passing.

G. No steel tape or chain will be allowed to cross or touch rails without permission from the Railroad.

13. GUIDELINES FOR EQUIPMENT ON RAILROAD RIGHT-OF-WAY:

A. No crane or boom equipment will be allowed to set up to work or park within boom distance plus 15’ of centerline of track without specific permission from railroad official and flagman.

B. No crane or boom equipment will be allowed to foul track or lift a load over the track without flag protection and track time.

C. All employees will stay with their machines when crane or boom equipment is pointed toward track.

D. All cranes and boom equipment under load will stop work while train is passing (including pile driving).

E. Swinging loads must be secured to prevent movement while train is passing.

F. No loads will be suspended above a moving train.

G. No equipment will be allowed within 25’ of centerline of track without specific authorization of the flagman.

H. Trucks, tractors or any equipment will not touch ballast line without specific permission from railroad official and flagman. Orange construction fencing may be required as directed.

I. No equipment or load movement within 25’ or above a standing train or railroad equipment without specific authorization of the flagman.

J. All operating equipment within 25’ of track must halt operations when a train is passing. All other operating equipment may be halted by the flagman if the flagman views the operation to be dangerous to the passing train.

K. All equipment, loads and cables are prohibited from touching rails.

L. While clearing and grubbing, no vegetation will be removed from railroad embankment with heavy equipment without specific permission from the Railroad Engineer and flagman.

M. No equipment or materials will be parked or stored on Railroad's property unless specific authorization is granted from the Railroad Engineer.

N. All unattended equipment that is left parked on Railroad property shall be effectively immobilized so that it cannot be moved by unauthorized persons.

O. All cranes and boom equipment will be turned away from track after each work day or whenever unattended by an operator.

P. Prior to performing any crane operations, the contractor shall establish a single point of contact for the Railroad flagman to remain in communication with at all times. Person must also be in direct contact with the individual(s) directing the crane operation(s).

14. INSURANCE:

A. The Contractor will be required to carry insurance in accordance with 103.04 of the Standard Specifications and the Railroad's requirements. In the event this project is awarded to a "joint venture" all insurance, except workman's compensation, shall be carried in the name of the joint venture.

B. Evidence of insurance as required above shall be furnished to the address shown. The original policies, or certificates, shall be sent to the railroad for it's review. Copies of the transmittal letter and the policies or certificates shall be forwarded to the Department.

Department:	Railroad:
Indiana Dept. of Transportation Construction Contracts Manager Government Center North 100 North Senate Avenue Indianapolis, IN 46204-2219	SEE ATTACHMENT "A"

C. Trains will be operated at a maximum speed of 45 mph through the improvement. The number of trains through the improvement will be 12 freight and 0 passenger trains daily.

D. The named insured, description of the work and designation of the job site to be shown on the Policy are as follows:

a. Named Insured: SEE ATTACHMENT "A"

b. Description and Designation: Indiana Department of Transportation Contract: B-40719 – I-64 Sherman Minton Bridge over Ohio River 2.24 Miles E of I-64/I-265 Interchange. Bridge Rehabilitation or Repair and Bridge Painting.

E. If any part of the work is sublet, similar insurance and evidence thereof in the same amounts as required of the Prime Contractor shall be provided by or in behalf of the subcontractor to cover his operations. Endorsements to the Prime Contractor's policies specifically naming

subcontractors and describing their operations will be acceptable for this purpose.

F. All insurance herein before specified shall be carried until all work required to be performed under the terms of the contract has been satisfactorily completed within the limits of the rights of way of the Railroad as evidenced by the formal acceptance by the Department. Insuring Companies may cancel insurance by permission of the Department and Railroad or on thirty (30) days written notice to the Railroad and copied to the Indiana Department of Transportation at the same addresses shown in Par. A above.

15. FAILURE TO COMPLY:

A. In the event the Contractor violates or fails to comply with any of the requirements of these Special Provisions:

a. The Railroad Engineer may require that the Contractor vacate Railroad property.

b. The Engineer may withhold all monies due the Contractor on monthly statements.

Any such orders shall remain in effect until the Contractor has remedied the situation to the satisfaction of the Railroad Engineer and the Engineer.

16. PAYMENT FOR COST OF COMPLIANCE:

A. No separate payment will be made for any extra cost incurred on account of compliance with these special provisions. All such costs shall be included in prices bid for other items of the work as specified in the payment items.

17. PROJECT INFORMATION

Date: **November 27, 2019**
NS File No: **TBD**
NS Milepost: **0267.630 W**
Department's Project No: **1702255**
Department's Contract No: **B-40719**

ATTACHMENT "A"

Insurance Requirements for Norfolk southern Railways

A. The Contractor will be required to carry insurance in accordance with 103.04 of the Standard Specifications and the Railroad's requirements. In the event this project is awarded to a "joint venture" all insurance, except workman's compensation, shall be carried in the name of the joint venture.

In addition to any other forms of insurance or bonds required under the terms of the contract and specifications, the Prime Contractor will be required to carry insurance of the following kinds and amounts:

a. Commercial General Liability Insurance having a combined single limit of not less than $2,000,000 per occurrence for all loss, damage, cost and expense, including attorneys' fees, arising out of bodily injury liability and property damage liability during the policy period. Said policy shall include explosion, collapse, and underground hazard (XCU) coverage, shall be endorsed to name Railroad specified in item A.2.c. below both as the certificate holder and as an additional insured, and shall include a severability of interests provision.

b. Automobile Liability Insurance with a combined single limit of not less than $1,000,000 each occurrence for injury to or death of persons and damage to or loss or destruction of property. Said policy or policies shall be endorsed to name Railroad specified in item A.2.c. below both as the certificate holder and as an additional insured and shall include a severability of interests provision.

c. Railroad Protective Liability Insurance having a combined single limit of not less than $2,000,000 each occurrence and $6,000,000 in the aggregate applying separately to each annual period. If the project involves track over which passenger trains operate, the insurance limits required are not less than a combined single limit of $5,000,000 each occurrence and $10,000,000 in the aggregate applying separately to each annual period. Said policy shall provide coverage for all loss, damage or expense arising from bodily injury and property damage liability, and physical damage to property attributed to acts or omissions at the job site.

The standards for the Railroad Protective Liability Insurance are as follows:

i. The insurer must be rated A- or better by A.M. Best Company, Inc.

NOTE: NS does not accept from insurers Chartis (AIG or Affiliated Company including Lexington Insurance Company), Hudson Group or Liberty or Affiliated Company, American Contractors Insurance Company and Erie Insurance Company including Erie Insurance Exchange and Erie Indemnity Company.

ii. The policy must be written using one of the following combination of Insurance Services Office ("ISO") Railroad Protective Liability Insurance Form Numbers:

a. CG 00 35 01 96 and CG 28 31 10 93; or

b. CG 00 35 07 98 and CG 28 31 07 98; or

c. CG 00 35 10 01; or

d. CG 00 35 12 04; or

e. CG 00 35 12 07; or

f. CG 00 35 04 13.

d. The named insured shall read:

Norfolk Southern Corporation and its subsidiaries
Three Commercial Place
Norfolk, Virginia 23510-2191
Attn: S. W. Dickerson Risk Management

(NOTE: NS does not share coverage on RRPL with any other entity on this policy)

e. The description of operations must appear on the Declarations, must match the project description in this agreement, and must include the appropriate Department project and contract identification numbers.

f. The job location must appear on the Declarations and must include the city, state, and appropriate highway name/number. NOTE: Do not include any references to milepost, valuation station, or mile marker on the insurance policy.

g. The name and address of the prime contractor must appear on the Declarations.

h. The name and address of the Department must be identified on the Declarations as the "Involved Governmental Authority or Other Contracting Party."

i. Endorsements/forms that are required are:

i. Physical Damage to Property Amendment

ii. Terrorism Risk Insurance Act (TRIA) coverage must be included

j. Other endorsements/forms that will be accepted are:

i. Broad Form Nuclear Exclusion – Form IL 00 21

ii. 30-day Advance Notice of Non-renewal or cancellation

iii. Required State Cancellation Endorsement

iv. Quick Reference or Index Form CL/IL 240

k. Endorsements/forms that are NOT acceptable are:

v. Any Pollution Exclusion Endorsement except CG 28 31

vi. Any Punitive or Exemplary Damages Exclusion

vii. Known injury or Damage Exclusion form CG 00 59

viii. Any Common Policy Conditions form

ix. An Endorsement that limits or excludes Professional Liability coverage

x. A Non-Cumulation of Liability or Pyramiding of Limits Endorsement

xi. An Endorsement that excludes TRIA coverage

xii. A Sole Agent Endorsement

xiii. Any type of deductible endorsement or amendment

xiv. Any other endorsement/form not specifically authorized in item no. 2.h above.

B. If any part of the work is sublet, similar insurance, and evidence thereof as specified in A.1 above, shall be provided by or on behalf of the subcontractor to cover its operations on Railroad's right of way.

C. All insurance required under the preceding subsection A shall be underwritten by insurers and be of such form and content, as may be acceptable to the Company. Prior to entry on Railroad right-of-way, the original Railroad Protective Liability Insurance Policy shall be submitted by the Prime Contractor to the Department at the address below for its review and transmittal to the Railroad. In addition, certificates of insurance evidencing the Prime Contractor's and any subcontractors' Commercial General Liability Insurance shall be issued to the Railroad and the Department at the addresses below, and forwarded to the Department for its review and transmittal to the Railroad. The certificates of insurance shall state that the insurance coverage will not be suspended, voided, canceled, or reduced in coverage or limits without (30) days advance written notice to Railroad and the Department. No work will be permitted by Railroad on its right-of-way until it has reviewed and approved the evidence of insurance required herein.

DEPARTMENT:

Indiana Dept. of Transportation
Contracts Engineer – Rm. N855
Government Center North
100 N. Senate Ave., N725
Indianapolis, IN 46204-2249

RAILROAD:

Risk Management
Norfolk Southern Corporation
and its subsidiaries
Three Commercial Place
Norfolk, VA 23510-2191

D. The insurance required herein shall in no way serve to limit the liability of Department or its' Contractors under the terms of this agreement.

E. Insurance Submission Procedures

a. Railroad will only accept initial insurance submissions via US Mail or Overnight carrier to the address noted in C above. Railroad will NOT accept initial insurance submissions via email or faxes. Please provide point of contact information with the submission including a phone number and email address.

b. Railroad requires the following two (2) forms of insurance in the initial insurance submission to be submitted under a cover letter providing details of the project and contact information:

   i. The full original or certified true countersigned copy of the railroad protective liability insurance policy in its entirely inclusive of all declarations, schedule of forms and endorsements along with the policy forms and endorsements.
   ii. The Contractor's commercial general, automobile, and workers' compensation liability insurance certificate of liability insurance evidencing a combined single limit of a minimum of $2M per occurrence of general and $1M per occurrence of automobile liability insurance naming Norfolk Southern Railway Company, Three Commercial Place, Norfolk, VA 23510 as the certificate holder and as an additional insured on both the general and automobile liability insurance policy.

c. It should be noted that the Railroad does not accept notation of Railroad Protective insurance on a certificate of liability insurance form or Binders as Railroad must have the full original countersigned policy. Further, please note that mere receipt of the policy is not the only issue but review for compliance. Due to the number of projects system-wide, it typically takes a minimum of 30-45 days for the Railroad to review.

INSURANCE APPROVAL REQUEST – To be sent with required evidence of insurance.

TO: Risk Management
Norfolk Southern Railway Corporation
Three Commercial Place
Norfolk, VA 23510-2191

Date: _____

NS Agreement With:_____
(Name of Public Authority, or contractor) Date_____

Name of Contractor: _____

(Provide both Indiana DOT Contract Number and Project Description along with Railroad Milepost Number when available)

Project Description: INDOT Contract:_____

Anticipated Starting Date:_____Completion Date:_____

City:_____County:_____State:_____

Railroad Division:_____Railroad Sub-Division:_____Railroad Milepost:_____

Attached are Original Railroad Protective Insurance Policy and certificate of general liability insurance required to be furnished to NSRR. Please advise if the attached evidence of insurance is satisfactory and complies with the insurance requirements of the agreement.

(Public Authority or Contractor must show address below and attach self-addressed, stamped envelope)

TO: _____ Date: _____
File: _____

☐ **Approved** this is not authority to proceed with work, Please Contact_____ ___at _____ to arrange clearance to enter railroad property.

☐ **Railroad Protective Not Approved.** Reason:
- ☐ Insurance Company not (A-1 or higher)
- ☐ Named insured/address incorrect
- ☐ Limits of insurance inadequate ($ xxx each occurrence $ xxx aggregate required).
- ☐ Project description inadequate
- ☐ Contractor's name and address incorrect or missing
- ☐ Name of governmental authority for whom work is being performed incorrect or missing
- ☐ Policy not countersigned
- ☐ Policy forms incorrect
- ☐ Other

☐ **General Liability Not Approved.** Reason:
- ☐ Limits inadequate ($ xxx required).
- ☐ Railway not named as certificate holder and additional insured.
- ☐ Other:

☐ Returned for your further handling.

Norfolk Southern Railway Company

_____
Risk Management

cc: INDOT Contracts Services Manager/Document Control Manager

CONTRACTOR WORKING ON BEHALF OF PROJECT SPONSOR
COSTS REIMBURSED BY PROJECT SPONSOR
NS FILE: _____
NORFOLK SOUTHERN
CONTRACTOR RIGHT OF ENTRY AGREEMENT

WHEREAS, _____ ("Principal") has requested that Norfolk Southern Railway Company ("Company") permit Principal to be on or about Company's premises and/or facilities at or in the vicinity of _____ (the "Premises") for the sole purpose of _____ , on behalf of _____ (the "Project Sponsor") during the period _____, 20____, to _____, 20____ (the "Right of Entry").

WHEREAS, Company is willing to grant the Right of Entry subject to the terms and conditions set forth herein.

NOW THEREFORE, in consideration of the foregoing and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, and intending to be legally bound hereby, the parties hereby agree as follows.

Company hereby grants Principal the Right of Entry. The Right of Entry shall extend to Principal and to subcontractors and other entities affiliated with Principal who are specifically approved for entry by authorized representatives of Company in writing, as well as to the officers and employees of the foregoing (collectively "Licensees"). The Right of Entry shall apply to those portions of the Premises, and to such equipment, machinery, rolling stock and other personal property and fixtures belonging to Company or otherwise located on the Premises, only to the extent specifically designated and approved in writing by authorized representatives of Company (collectively, "Designated Property").

Principal agrees:

(i) that Licensees' access to the Premises shall be limited to the Designated Property and that Principal shall be liable and fully responsible for all actions of Licensees while on the Premises pursuant to the Right of Entry;

(ii) that Licensees shall (a) be subject to Company's direction when upon the Premises, and (b) be subject to Company's removal from the Premises, in Company's sole discretion, due to negligence, misconduct, unsafe actions, breach of this agreement or the failure to act respectfully, responsibly, professionally, and/or in a manner consistent with Company's desire to minimize risk and maintain its property with maximum security and minimum distractions or disruptions or for any other lawful reason;

(iii) that Licensees shall perform all work with such care, diligence and cooperation with Company personnel as to reasonably avoid accidents, damage or harm to persons or property and delays or interference with the operations of any Company's facilities and in accordance with Company's "Special Provisions for Protection of Railway Interest", attached and incorporated herein.

(iv) to give Company's officer signing this agreement, or his or her authorized representative, advance notification of the presence of Licensees on Designated Property in accordance with Company's "Special Provisions for Protection of Railway Interest";

(v) to indemnify and save harmless Company, its officers, agents and employees from and against any and all claims, demands, losses, suits, judgments, costs, expenses (including without limitation reasonable attorney's fees) and liability resulting from (a) injury to or death of any person, including without limitation the Licensees, and damage to or loss of any property, including without limitation that belonging to or in the custody of Licensees (the "Licensee Property"), arising or in any manner growing out of the presence of either the Licensees or the Licensee Property, or both, on or about the Premises, regardless of whether negligence on the part of Company, its officers, agents or employees caused or contributed to said loss of life, personal injury or property loss or damage in whole or in part; (b) any alleged violation of any law, statute, code, ordinance or regulation of the United States or of any state, county or municipal government (including, without limitation, those relating to air, water, noise, solid waste and other forms of environmental protection, contamination or pollution or to discrimination on any basis) that results in whole or in part, directly or indirectly, from the activities of Licensees related in any way to their presence on the Premises or from any other act or omission of Licensees contributing to such violation, regardless of whether such activities, acts or omissions are intentional or negligent, and regardless of any specification by Company without actual knowledge that it might violate any such law, statute, code, ordinance or regulation; (c) any allegation that Company is an employer or joint employer of a Licensee or is liable for related employment benefits or tax withholdings; or (d) any decision by Company to bar or exclude a Licensee from the Premises pursuant to subsection (ii)(b) above;

(vi) to have and keep in effect the appropriate kinds of insurance as listed in the Company's "Special Provisions for Protection of Railway Interest, with insurance companies satisfactory to Company, during the entire time Licensees or Licensee Property, or both, is on the Premises: and to provide certificates of insurance showing the foregoing coverage, as well as any endorsements or other proper documentation showing and any change or cancellations in the coverage to the Company officer signing this agreement or to his or her authorized representative;

(vii) to reimburse Company for any costs not covered under the existing project agreement between the Company and the Project Sponsor, including any material, labor, supervisory and protective costs (including flagging) and related taxes and overhead expenses required or deemed necessary by Company because of the presence of either Licensees or Licensee Property on the Premises;

(viii) to exercise special care and precautions to protect the Premises and equipment, machinery, rolling stock and other personal property and fixtures belonging to Company or otherwise located on the Premises (whether or not constituting Designated Property) and to avoid interference with Company's operations;

(ix) to not create and not allow drainage conditions which would be adverse to the Premises or any surrounding areas;

(x) to refrain from the disposal or release of any trash, waste, and hazardous, dangerous or toxic waste, materials or substances on or adjacent to the Premises and to clean up or to pay Company for the cleanup of any such released trash, waste, materials or substances; and

(xi) to restore the Premises and surrounding areas to its original condition or to a condition satisfactory to the Company officer signing this agreement or to his or her authorized representative (ordinary wear and tear to rolling stock and equipment excepted) upon termination of Licensees' presence on the Premises.

As a part of the consideration hereof, Principal further hereby agrees that Company shall mean not only Norfolk Southern Railway Company but also Norfolk Southern Corporation and any and all subsidiaries and affiliates of Norfolk Southern Railway Company or Norfolk Southern Corporation, and that all of Principal's indemnity commitments in this agreement in favor of Company also shall extend to and indemnify Norfolk Southern Corporation and any subsidiaries and affiliated companies of Norfolk Southern Railway Company or Norfolk Southern Corporation and its and/or their directors, officers, agents and employees.

It is expressly understood that the indemnification obligations set forth herein cover claims by Principal's employees, agents, independent contractors and other representatives, and Principal expressly waives any defense to or immunity from such indemnification obligations and/or any subrogation rights available under any applicable state constitutional provision, laws, rules or regulations, including, without limitation, the workers' compensation laws of any state. Specifically, (i) in the event that all or a portion of the Premises is located in the State of Ohio, the following provision shall be applicable: "Principal, with respect to the indemnification provisions contained herein, hereby expressly waives any defense or immunity granted or afforded it pursuant to Section 35, Article II of the Ohio Constitution and Section 4123.74 of the Ohio Revised Code"; and (ii) in the event that all or a portion of the Premises is located in the Commonwealth of Pennsylvania, the following provision shall be applicable: "Principal, with respect to the indemnification provisions contained herein, hereby expressly waives any defense or immunity granted or afforded it pursuant to the Pennsylvania Workers' Compensation Act, 77 P.S. 481".

This agreement shall be governed by the internal laws of the Commonwealth of Virginia, without regard to otherwise applicable principles of conflicts of laws. If any of the foregoing provisions is held for any reason to be unlawful or unenforceable, the parties intend that only the specific words found to be unlawful or unenforceable be severed and deleted from this agreement and that the balance of this agreement remain a binding enforceable agreement to the fullest extent permitted by law.

This agreement may be amended only in a writing signed by authorized representatives of the parties.

_____	NORFOLK SOUTHERN RAILWAY COMPANY
Name of Principal	
By_____	
By_____	
Title _____	Title
_____	
Date _____, 20____	Date _____, 20_____

ATTACHMENT 17-1

UNIQUE SPECIAL PROVISIONS

ITS

1. ATMS DOCUMENTATION AND SUBMITTALS
2. ATMS ELECTRICAL IDENTIFICATION
3. ATMS GENERAL ELECTRICAL REQUIREMENTS
4. ATMS GENERAL REQUIREMENTS
5. ATMS GROUNDING
6. ATMS POWER SERVICE DROP
7. ATMS TRACER WIRE
8. CABLE DUCT MARKER
9. CCTV ASSEMBLY
10. FIBER OPTIC BACKBONE CABLE
11. FIBER OPTIC CABLE SPLICE
12. FIBER OPTIC DROP CABLE
13. FIBER OPTIC LOCATOR POST
14. FIBER OPTIC PATCH PANEL ASSEMBLY
15. HANDHOLES
16. ITS, CELLULAR MODEM ASSEMBLY
17. ITS FIELD SWITCH
18. ITS FOLDING POLE, CCTV
19. ITS POLE STRUCTURE
20. FOUNDATION, ITS POLE STRUCTURE
21. PADLOCKS
22. REMOTE POWER SWITCH
23. SURGE PROTECTION DEVICES FOR ATMS COMMUNICATIONS, VIDEO, AND 24V
24. VAULT, ATMS
25. WIRELESS VEHICLE DETECTION SYSTEM

ATMS DOCUMENTATION AND SUBMITTALS

Description

The Contractor shall provide four types of documentation and submittals for this contract: wiring diagrams and system schematics, submittal data, as-built documentation, and manuals and maintenance documentation. The Contractor shall submit working drawings in accordance with 105.02 and the following additional requirements.

All documentation, except as approved by the Engineer, shall be no smaller than 8½ in. by 11 in. or no larger than 24 in. by 36 in. Standard bound manuals shall be exempted from this requirement. The Department shall maintain the right to reproduce unlimited copies of any documentation for exclusive use on this contract.

All documentation shall also be provided in electronic format and delivered on CD-ROM as practical. All electronic files shall be readable using standard Microsoft Office products. Drawings shall be provided as CAD files in data exchange (.DXF) file format compatible with MicroStation and in Acrobat Reader (.PDF) file format.

All 8½ in. by 11 in. documentation, except standard bound manuals, shall be bound in logical groupings in three ring loose-leaf binders. Binders may also include 11 in. by 17 in. documentation, if Z-folded. Three copies of each bound grouping of documentation shall be provided labeled in a legible and permanent manner.

Three copies of all 24 in. by 36 in. documentation and a single reduced set no smaller than 11 in. by 17 in. shall be provided.

All documentation submitted shall be of reproducible quality as determined by the Engineer. All unsatisfactory items will be returned to the Contractor who shall make the submittal again in satisfactory reproducible form as determined by the Engineer.

All literature from manufacturers shall be original documents provided by the manufacturers. Black and white copies of color originals are not acceptable. No facsimile reproductions of any type shall be accepted.

Wiring Diagrams

Wiring diagrams and system schematics shall be prepared and meet the following requirements:

1. Include wire designations by color or labels for every piece of field equipment in every cable segment between the equipment.
2. Include appropriate designations for every cable and conduit segment. All conduits carrying electrical cables shall be marked or labeled at all maintenance points and points of access. Designations shall include terminology such as, "Power Distribution – 480 VAC", "Video Coax", etc. All designations shall be submitted to the Engineer for approval prior to submittal.
3. Show locations of all cable splices.
4. Show connections to all communications equipment at the remote sites, CDP sites, and at the Traffic Management Center.
5. All radio equipment documentation packages shall include system diagrams, interconnection drawings, parameter lists and optimization procedures.

Submittal Data

Submittal Data shall be prepared and meet the following requirements:

Prior to the purchase or fabrication of any equipment or material proposed for use on this project, the Contractor shall submit for review by the Engineer catalog cut sheets and specifications for all standard, off-the-shelf items; working drawings shall be submitted for all non-catalog or custom items. An electronic copy of all submittals and working drawings shall be provided in .pdf format. In lieu of electronic copies the Contractor may choose to submit ten paper copies of submittals and working drawings. Every submittal shall be accompanied by transmittal letter providing following information:

1. Submittal number
2. Pay item number
3. Manufacturer and model number
4. Description

Submittals and working drawings will be approved or rejected in writing, and a memorandum stating the disposition will be returned to the Contractor. Certain items will require verification of performance, which shall be provided with the catalog cut sheets, working drawings, and specifications. See individual equipment specifications for requirements.

The purpose of the submittal and working drawing data is to show specifically and in detail how the Contractor intends to satisfy the requirements of these specification and the plans. If preprinted literature is utilized to satisfy some or all of these requirements, there shall be no statements on the literature which conflict with these specifications or plans. Any such statements will be crossed off and initialed by the Contractor and an appropriate statement be attached indicating how the requirements of these specification or the plans will be fulfilled.

The Contractor shall label each item of submittal and working drawing data with the bid item number or other description of the items to which it applies. Each submittal of catalog cut sheets, specifications, or working drawings, shall contain sufficient information and details to allow the Engineer to evaluate the particular component.

Copies of the catalog cut sheets, specifications, and working drawings shall be submitted by the Contractor to the Engineer and the ITS Field Engineer, whom will be introduced at the preconstruction meeting. All catalog cut sheets and specification submittal data shall be submitted within 30 calendar days following issuance of the Notice to Proceed. All working drawings shall be submitted within 90 calendar days following issuance of the Notice to Proceed. Failure to submit catalog cut sheets, specifications and working drawings within this time frame shall result in **liquidated damages of $1000 per day** to be withheld from Contractor payment.

All submittals will be returned to the Contractor within 30 days of submission. All submittals returned to the Contractor as rejected shall be resubmitted for approval within 14 calendar days from the notice of rejection. Failure to resubmit documentation within the 14 calendar days from notice of rejection will result in **liquidated damages of $1000 per day** to be withheld from Contractor payment.

The Contractor may submit alternatives to the Plans and Special Provisions

to the Department for consideration. Any alternative submitted shall be identified with benefits stated and documented.

The Contractor shall submit the following items at a minimum. Any item included in this list that is not a deliverable of the contract may be removed from the requirements with approval by the Engineer. This list does not preclude the submittal of other items as required in the specifications. The submittal requirement items are as follows;

1. Fiber optic cable
2. Fiber optic drop cable assemblies
3. Fiber optic patch panels
4. Fiber optic patch cables
5. Fiber optic break out kit and connectors
6. Fusion splice protection kit
7. Fusion splice enclosure
8. Small Form-Factor Pluggable Transceivers (SFPs)
9. Vaults
10. Handholes
11. Handhole and vault rings & lids
12. Cable duct markers, concrete
13. Cable duct markers, flexible (including decal design)
14. All conduits
15. All electrical and grounding cables
16. Cell Modems
17. Conduit splicing methods and materials
18. Dynamic Message Sign Structure
19. Dynamic Message Sign Structure Foundation
20. DMS Panels and Signs
21. ITS Cabinet
22. Wireless Vehicle Detection System
23. Monopole
24. Monopole Foundation
25. Camera Assemblies
26. Computers

As-Built Documentation

Documentation of the work, as-built, shall be provided by the Contractor prior to acceptance of the work. The Contractor will be provided with base files containing the proposed locations for conduit, cabinets, and devices. On a level containing no proposed information, the Contractor shall draw in the final as-built locations for the cabinets, poles, conduits including burial depth, and device locations. These drawings shall be returned in both electronic and paper format.

As part of the final as-built documentation the Contractor shall provide GPS coordinates accurate within 3 ft. of a CCTV, DMS, Cabinet, or Service point location. The coordinates shall be noted on the plans and in a single spreadsheet form provided to the Department on a compact disk, CD.

As part of the final as-built documentation the Contractor shall provide GPS coordinates accurate within 3 ft. of all handhole and vault locations. The coordinates shall be noted on the plans and in a single comma separated value, CSV, file provided to the Department. The CSV file shall be supplied on a CD to the Department including the Latitude and Longitude of all handhole and vault locations in decimal degree format. Each record shall include the type of object, Latitude, Longitude, Road Name, direction of roadway travel, and Nearest

Mile Marker to the nearest tenth of a mile. The following is an example of the record format;

Example record: Vault, 39.40247778, -86.44611111, I-69, NB, 136.7

This would be the location record for a vault placed along I-69, on the NB side of the road, at the 136.7 mile marker near the interchange with SR 39.

Component and wiring diagrams shall be provided for all custom manufactured equipment as well as a complete parts listing indicating the manufacturer and model of all electronic components.

In addition to the documentation specified elsewhere, prints of schematic diagrams applicable to the equipment contained in cabinets or the communication shelters shall be provided by the Contractor. An 11 in. by 17 in. laminated wiring diagram, and an 11 in. by 17 in. laminated site drawing shall also be supplied in a weatherproof holder and mounted at each new cabinet and communication shelter.

Manuals and Maintenance Documentation

Two manuals shall be supplied for each individual component of the system. A reproducible form of the manual shall also be provided. The manuals supplied for the off-the-shelf items shall be those supplied by the equipment manufacturer.

Manuals shall include, at a minimum, the following material:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and schedules.

The Contractor shall provide a maintenance history for each piece of electronic equipment provided on this contract. This history shall include the equipment type, model and serial numbers, date of manufacture, date and location of installation, date of all associated tests required by these specifications and the performance of the equipment during these tests.

Any maintenance activity performed on the unit because of a failure shall be documented, and shall include: an explanation of all failures, date that the equipment was removed from a cabinet, the repairs that were made, the date and nature of any tests made to check the correct operation of the unit, and the date and the location where the unit was reinstalled in the field.

After each repair conducted, prior to acceptance, the warranty period shall be renewed. No more than one repair shall be allowed prior to acceptance. If a second repair is required, the equipment shall be replaced in kind with a new warranty period.

Method of Measurement

ATMS Documentation and Submittals will not be measured.

Basis of Payment

System documentation will be considered incidental to the cost of equipment being provided on this contract and will not be paid for separately.

ATMS ELECTRICAL IDENTIFICATION

Description

The Contractor shall provide labeling and signing to clearly identify all new electrical equipment and conduits installed for ATMS equipment on this project. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labeling for conduits, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

Electrical Component Standard:
Components and installation shall comply with NFPA 70 of the NEC.

ANSI Compliance:
Comply with requirements of ANSI Standard A13.1, Scheme for the Identification of Piping Systems, with regard to type and size of lettering for raceway and cable labels.

Materials

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, or a manufacturer with equal products, the following:

1. American Labelmark Co.
2. Ideal Industries, Inc.
3. National Band and Tag Co.
4. Panduit Corp.
5. Seton Name Plate Co.
6. Standard Signs, Inc.
7. W.H.Brady, Co.

Adhesive Marking Labels for Raceway and Metal-clad Cable: *Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Power, ATMS).*

Label Size for conduits larger than 1 in.: 1.10 in. high by 7.87 in. long.
Color: Black legend on orange background.
Colored Adhesive Marking Tape for Conduits, Wires, and Cables: Self-adhesive vinyl tape not less than 0.003 in. thick by 0.98 in. to 1.96 in. width.

Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 5.88 in. wide by 0.004 in. thick. Printed legend indicative of general type of underground line below.

Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 0.059 in. minimum thick for signs up to 20.0 sq. in, or 7.87 in. in length; 0.118 in. thick for larger sizes. Engraved

legend in white letters on black face and punched for mechanical fasteners.

Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.177 in. minimum width, 48.5 lb. minimum tensile strength, and suitable for a temperature range from minus 50° F to 348.8° F. Provide ties in specified colors when used for color coding.

Construction Requirements

Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

Underground Electrical Line Identification:

During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker, located above line at 6 in. to 8 in. below finished grade.

Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 in.; install a single line marker.

Conductor Color Coding:

Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

Table 1: Conductor Color Coding Convention

Phase	120/240 Volts	240/480 Volts
A	Black	Brown
B	Red	Orange
Neutral	White	White
Ground	Green	Green

For phase conductors:

1. At a weatherhead: Identify conductors with pressure sensitive plastic tape applied in half-lapped turns for a distance of 6 in. from the terminal points and in boxes where splices are made.
2. All other locations: Identify conductors with color factory applied the entire length of the conductors or pressure sensitive plastic tape applied in half-lapped turns for a distance of 6 in. from the terminal points and in boxes where splices are made.

For Neutral and Ground conductors: Use conductors with color factory-applied the entire length of the conductors except as follows:

The following field-applied color-coding methods may be used for receptacle phase conductors on sizes larger than No. 6 AWG.

1. Pressure-sensitive plastic tape shall be applied in half-lapped turns for a distance of 6 in. from terminal points and in boxes where splices or taps are made. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Use 1 in. wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

2. In lieu of pressure-sensitive tape, cable ties may be used for color identification. Three ties of specified color shall be applied to

each wire at each terminal or splice point starting 3 in. from the terminal and spaced 3 in. apart. A special tool or pliers shall be used to, tighten for a snug fit, and cut off excess length.

Tag or label conductors as follows:

1. Where multiple branch circuits are present in the same conduit, box or enclosure, label each conductor or cable, including each neutral.
2. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring in each panel.
3. Phase and voltage of branch circuit wiring may be indicated by means of coded color of conductor insulation.
4. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

Warning, caution, and instruction signs and stencils shall be applied as follows:

1. Install warning, caution, or instruction signs where required by NEC or OSHA, where indicated, or where required to assure safe operation and maintenance of electrical systems and of the items to which they connect.
2. Install engraved plastic- laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.
3. Install butyrate signs with metal backing for outdoor items.

Method of Measurement

Electrical Identification will not be measured.

Basis of Payment

Electrical Identifications will be considered incidental to the cost of all electrical equipment furnishings and installations. The materials, equipment, and installation of identification, warning tags and labels shall be considered incidental and will not be paid for separately.

ATMS GENERAL ELECTRICAL REQUIREMENTS

Description

This Section includes general administrative and procedural requirements for electrical installations. The following sections of the Standard Specifications relate specifically to electrical work 807, Highway Illumination; 805, Traffic Signals; 809, ITS; and 920.01(g), Working Drawings. Required material and product certifications shall be in accordance with 916.

Construction Requirements

Electrical Installation:

Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other roadway components.
2. Verify all dimensions by field measurements.
3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
4. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
5. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
6. Install systems, materials, and equipment level and plumb, unless otherwise specified.
7. All work and materials shall comply with the NEC, NFPA 70, as adopted by the State.

Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

Method of Measurement

ATMS General Electrical Requirements will not be measured.

Basis of Payment

ATMS General Electrical Requirements will be considered incidental to the cost of equipment being provided on this contract and will not be paid for separately.

ATMS GENERAL REQUIREMENTS

Description

The work and methods described herein are general and applicable to all equipment, components, and software to be furnished and installed. Unless otherwise specified, all equipment, components, and software shall conform to these requirements.

Materials

All procurement shall be made on new materials and equipment. The procurement shall be in accordance with the current applicable standards of the following; National Electrical Manufacturers Association, NEMA; Electronics Industries Association, EIA; National Electrical Code, NEC; Underwriters Laboratory, UL. All equipment shall be obtained from qualified vendors approved by the Department.

All controls, indicators, and connectors shall be labeled in a clear and permanent manner approved by the Engineer.

All electronic and electrical components assemblies or digital control devices that are connected to commercial power shall be UL (Underwriters Laboratories) or ETL (Electronics Testing Laboratories) listed or, if not listed, shall first be approved by the Engineer. This includes, but is not limited to: power supplies, relays, video monitors, wiring, and wiring accessories. Copies of UL or ETL product cards shall be provided to the Engineer to document the listings. All data and low power connections shall be accomplished via positive locking mechanisms.

Delivery

The Contractor shall deliver products to a location as determined by the Department each identified with name, model number, type, grade, compliance labels, and other information needed for identification.

Rough-In

All final locations for rough-ins shall be verified with field measurements per the requirements of the actual equipment to be connected.

Installation

Connectors, terminals, bus joints, and mountings shall be checked for tightness by the Contractor. Field-connected connectors and terminals, including screws and bolts, shall be tightened in accordance with equipment manufacturers' published torque tightening values. Where manufacturers’ torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A. Scratches and mars of finish shall be touched up to match original finish. Remove paint splatters and other spots, dirt, and debris.

Outdoor Equipment

All conductive connectors, pins (except pins connected by soldering), and socket contacts shall be gold plated. Except for integrated circuits containing custom firmware, all components shall be soldered to the printed circuit board.

Custom Equipment

Equipment that is not part of a manufacturer's or vendor’s standard product line, or that is made or modified for this project, shall conform to the following:

1. Design specifications and drawings for custom equipment shall first be submitted to the Engineer for review and approval. The Department reserves all rights to use any custom equipment throughout the State of Indiana at their convenience without restriction or license. Agreements of non-disclosure or product rights will be considered by the Department upon written request.
2. Where practical, electronics shall be modular plug-in assemblies to facilitate maintenance. Such assemblies shall be keyed to prevent incorrect insertion of modules into sockets.
3. All components shall be available from multiple manufacturers as part of the manufacturers' standard product lines. All custom components will be labeled with the value, part number, tolerance, or other information sufficient to enable a technician to order an exact replacement part.
4. Lamps used for indicator purposes shall be light-emitting diodes.
5. The printed circuit boards shall be composed of two-ounce copper on 0.063 in. thick fiberglass epoxy or equivalent type construction. Holes, which carry electrical connections from one side of the board to the other, shall be plated through. Multilayer printed circuit boards shall not be used. The name or reference number used for the board in the drawings and maintenance manuals supplied to the Department shall be permanently affixed to each board. Alternatives may be submitted for approval of the Engineer. Each circuit board shall be labeled with a unique serial number and part number that identifies the part to the manufacturer’s revision and quality control documentation.
6. All components shall be mounted so that the identifying markings are visible without moving or removing any part, if practical.

All equipment requiring FCC type approval, acceptance or certification shall have such approval, acceptance and certification at time of shipment.

All electronic equipment shall be solid state and reflect the latest advances in state-of-the-art design. All equipment and materials shall be new and free of corrosion, scratches and other defects. All equipment shall meet or exceed the applicable standards of the EIA.

Lightning/surge protection will be provided for all installed hardware in accordance with Motorola R-56.

Environmental Conditions

ATMS equipment shall continue to operate as specified under the ranges of environmental conditions specified by NEMA TS-2, except as noted for individual pieces of equipment.

Vibration and Shock

The equipment, when packaged in its normal shipping container, shall not be damaged, nor shall the operational performance be degraded after exposure to vibrations of 1g, 15 Hz to 500 Hz, or shocks of 5g, 10 ±1 milliseconds in each of three mutually perpendicular planes.

Camera assemblies, vehicle detection assemblies, and communications radios and antennas, and any other equipment mounted atop poles or structures shall not be impaired by the continuous vibration caused by winds and traffic.

Duty Cycle

The duty cycle of all equipment shall be continuous.

Electromagnetic Radiation

The equipment shall not be impaired by ambient electrical or magnetic fields, such as those caused by power lines, transformers, and motors. ATMS equipment supplied under this contract shall not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, industrial, and medical equipment.

Electrical Power

The electrical power requirements shall be in accordance with the following:

1. Operating Power: The equipment shall operate on single phase, 3 wire 120/240 VAC, 60 Hz, unless otherwise specified. It shall conform to its specified performance requirements when the input voltage varies from 89 to 135 volts and the frequency varies ±3 Hz.

2. High Frequency Interference: The equipment operation shall be unaffected by power supply voltage spikes of up to 150 volts in amplitude and ten microseconds duration.

3. Line Voltage Transients: The equipment operation shall be unaffected by voltage transients of plus or minus 20 percent of nominal line voltage for a maximum duration of 50 milliseconds. Equipment in the field shall meet the power service transient requirements of NEMA Standard TS-1 when connected to the surge protectors in the cabinets.

4. Protection: All equipment shall use readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

5. Brownouts: The equipment shall not be damaged when the main power drops to 95 VAC for a period of eight hours. If the equipment does not operate normally at 95 Volts, the equipment shall automatically resume normal operation within five seconds after normal power returns.

Temperature and Humidity:

The temperature and humidity requirements shall be in accordance with the following:

1. Field Equipment: Equipment in the field shall meet the temperature and humidity requirements of NEMA Standard TS-1. Liquid crystal displays shall be undamaged by temperatures as high as 165° F, and shall produce a usable display at temperatures up to 122° F.

2. Central Equipment: Central equipment shall operate normally at any combination of temperatures between 50° F and 104° F, and humidity between five percent and 90 percent, non-condensing, and with a temperature gradient of 41° F, per hour.

Wiring

The wiring requirements shall be in accordance with the following:

Every conductor, except a conductor contained within a single piece of equipment, shall terminate either in a connector or on a terminal block. The Contractor shall provide and install the connectors and terminal blocks where

needed. Approved splice kits shall be used instead of connectors.

Connectors shall be labeled and keyed to preclude improper connection. The permanent labeling methods shall be approved by the Engineer prior to use.

Appropriate designations shall be used for every conduit and cable segment. All conduits carrying electrical cables shall be marked or labeled at all maintenance points and points of access. Designations shall include terminology such as, "Power Distribution 480 VAC", "RF Coax", "Video Coax", "Video Fiber". All designations shall be approved by the Engineer. Labels shall be done in accordance with these Special Provisions.

Terminal blocks shall be affixed to panels that identify the block and what wire connects to each terminal. This may be accomplished by silk screening or by installing a laminated printed card under the terminal block, with the labels on portions of the card that extend beyond the block. Installation of terminal blocks by drilling holes in the exterior wall of the cabinet is not acceptable.

Personnel shall be protected from accidental contact with all dangerous voltages.

Conductors carrying AC power shall not be installed in the same wiring harness as conductors carrying DC control or communication or video signals.

Wiring shall be arranged so that any removable assembly can be removed without disturbing wiring that is not associated with the assembly being removed.

All splices, excluding permissible fiber optic cable, shall be in equipment cabinets. Fiber optic splices shall be in ATMS vaults. All splices shall be watertight and capable of satisfactory operation under continuous submersion in water. Splicing materials, insulation, and techniques shall be approved by the Engineer.

Electrical cables shall have at least 10 ft. of slack in all handholes and 6 ft. of slack in all cabinets, unless otherwise approved by the Engineer.

Unless otherwise stated herein or shown on the Plans, hot dipped galvanized steel shall be used for all exposed metal surfaces. Corrosion protection shall be provided between dissimilar metals.

Software

Controller Software: The Contractor shall deliver the most current versions of software working, tested, and complete with all necessary data files. For all software, except for commonly used, commercial software packages that are not supplied by an equipment manufacturer and that have not been modified for this project, the Contractor shall furnish well documented protocol, interface documentation and technical support as required to integrate the intended application and hardware into the system. A non-disclosure affidavit will be signed by the Department or a Department-approved representative if required. Deliver the software shall be made in all of the following ways:

1. Installed on the hard disk or, for controller software on a PROM

integrated circuit, executable code and data files only.
2. On two identical sets of portable storage media approved by the Engineer.
3. As printouts, 2 copies of data files and source code.

In order for the software to be accepted, the Contractor shall demonstrate that the source code and other items on the portable storage media are sufficient to create the working software provided by the Contractor. The Contractor shall demonstrate that the working executable program delivered on the hard disk or PROM is identical to the one produced in the demonstration.

Department's Rights: The Contractor shall provide licensed copies to the Department of any Commercial Off-the-Shelf Software (COTS) purchased from a third party. Adequate licensed copies of the software shall be provided as specified herein.

Serviceable Parts

The Contractor shall certify that all serviceable parts are commercially available or readily available from the system vendors and suppliers. The system vendors and suppliers shall provide a letter to the Department stating that all current and future models of serviceable parts for all ATMS equipment components shall be backwards compatible. Components that shall be backwards compatible include, but are not limited to: vehicle detectors, closed circuit television cameras, pan-tilt-zoom mechanisms, all video control equipment, component software, and all communication equipment including fiber optic equipment, radios, antennas, and cables.

Parts shall be shipped within five business days of receiving an order from the Department. These parts, at a minimum, shall be easily serviceable by the Department maintenance personnel using standard tools or tools provided to the Department by the Contractor. The Department will not agree to any implied or written arrangement to purchase any part from an exclusive source.

The Department shall have unlimited rights to software licenses. All source code shall be held in escrow by the Contractor.

Method of Measurement

ATMS General Requirements will not be measured.

Basis of Payment

ATMS General Requirements will be considered incidental to the cost of equipment being provided on this contract and will not be paid for separately.

Tools provided by the Contractor shall become the property of the Department and shall be considered incidental to the cost of other pay items, no additional payment will be made.

ATMS GROUNDING

Description

This work includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified herein may be supplemented in other sections of these specifications. All ground wires shall be tinned copper.

The Contractor shall design a ground system for each type of remote site and submit Plans in the form of a design drawing for approval by the Engineer. The design shall be certified by a Professional Engineer in the State of Indiana.

The work shall be completed in accordance with 807 and 922.07. This work shall also comply with Motorola R-56, Motorola Standards and Guidelines for Communications Sites 2000, Chapter 6, External Grounding. Where conflicts exist between Motorola R-56 and specifications, the more stringent requirement shall prevail.

Materials

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, or manufacturers with equal products, the following:

1. O-Z/Gedney Co.
2. Alltec Corporation
3. American Electric/Blackburn
4. Thomas & Betts Corp.

Grounding and Bonding Products:

Products of types indicated and of sizes and ratings to comply with the NEC. Where types, sizes, ratings, and quantities indicated in these Specifications, Plans, Motorola R-56, or 807 are in excess of the NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern. Conductor materials shall be copper.

Wire and Cable Conductors:

1. Aluminum wire and cable shall not be used.
2. In general, conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
3. Equipment Grounding Conductor shall be green insulated.
4. Grounding Electrode Conductor shall be solid copper wire.
5. Bare Copper Conductors shall be solid copper wire: ASTM B-3.
6. Assembly of Stranded Conductors in accordance with ASTM B-8.
7. Tinned Conductors in accordance with ASTM B-33.

Miscellaneous Conductors:

1. Ground Bus shall be bare annealed copper bars of rectangular cross section.

Connector Products:

1. In general shall be listed and labeled as grounding connectors for the materials used.
2. Pressure Connectors shall be high-conductivity-plated units.
3. Bolted Clamps shall be heavy-duty units listed for the application.
4. Exothermic Welded Connections shall be provided in kit form and

selected for the specific types, sizes, and combinations of conductors and other items to be connected.

Grounding Electrodes:

Ground Rods shall be copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core. Electrolytic ground rods maybe used, if required by soil conditions, with the approval of the Engineer. Ground rods shall be 5/8 in. by 10 ft.

Construction Requirements

Electrical systems and equipment shall be grounded in accordance with Motorola R-56 and NEC requirements except where exceed by the plans or the specifications.

Listing and Labeling:

Products provided shall be listed and labeled. The terms "listed" and "labeled" shall be in accordance with NEC, Article 100.

Electrical Component Standard:

Components and installation shall comply with NFPA 70 of the NEC.

UL Standard:

Grounding and bonding equipment shall comply with UL 467, Grounding and Bonding Equipment.

Equipment Grounding Conductor Application:

Equipment grounding conductors shall comply with NEC Article 250 for size and quantity, except where larger sizes or more conductors are indicated on the plans or by Motorola R-56.

Connections:

In general, make connections in such a manner as to minimize galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be compatible and prevent galvanic action. The following requirements shall also apply:

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to the contact surfaces.

Exothermic Welded Connections:

Use for connections to structural steel, for all underground connections, and for all connections to ground rods and plate electrodes. Comply with manufacturer’s written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic conduits terminate at metallic housings without mechanical and electrical connection to the

housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Non-continuous, metallic conduits shall be bonded, in an electrical manner, at one end with grounding bushings and bare grounding conductors.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values for connectors and bolts. Where manufacturer's torqueing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A.

Ground Rod Installations:

Ground rounds shall be driven into the earth. The top of the ground rod shall be a minimum of 12 inches below finished grade. Conductor terminations to the ground rod shall be made by exothermic welds, rated for underground installation.

Compression-Type Connections:

Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

Moisture Protection:

Where insulated ground conductors terminated underground insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

Field Quality Control:

The procedures for performing resistance testing of the site grounding electrode system shall comply with the following:

The resistance of a grounding electrode system shall be measured after its installation and before it is bonded to the power company neutral wire or any other utility, such as the telephone ground or metallic pipes.

Resistance testing shall be done using the Three-Point/Fall-of-Potential method. The Three-Point/Fall-of-Potential test is the most widely accepted and recommended test method. This procedure is documented in ANSI/IEEE STD 81 and shall be referred to for more details. The testing shall be done in accordance with Motorola R-56. An instrument designed specifically to measure the resistance of a point to each ground shall be used and the instructions provided with the instrument shall be followed for proper measurement method. All measurements shall be recorded along with the location of each ground rod and submitted to the Engineer.

Upon completion of all grounding requirements outlined in these Special Provisions and other applicable documents, the ground resistance for Configuration G sites shall be 4 Ohms or less, all Configuration J shall be 25 Ohms or less, and all other sites shall be 10 Ohms or less.

Deficiencies:

Where ground resistances exceed specified values, the Contractor shall modify the grounding system to reduce resistance values. Additional costs for materials and labor used in these modifications will be considered incidental to the cost of the grounding system.

Reporting:

Prepare test reports of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

Cleaning and Adjusting:

Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated.

Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work to their original condition. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging, or mulching. Maintain disturbed surfaces, restore vegetation, and restore disturbed paving.

Inspection:

The grounding system will be inspected by the Engineer using the checklist from Motorola R-56 Appendix F pages 601 through 643, as applicable.

Method of Measurement

Grounding will not be measured for payment.

Basis of Payment

Grounding will not be paid for separately and will be considered incidental to the cost of electrical equipment, cabinets, and ATMS equipment. No separate payment will be made for equipment grounding unless otherwise specifically stated herein.

ATMS POWER SERVICE DROP

Description

Work under this item shall include furnishing and installing all equipment necessary to provide a complete service point power entry for ATMS equipment. Electrical service, where required, shall be provided by power utility which services the location of the service point. Provide a 100 Amp, 120/240 VAC, 1-phase, 3-wire service or a 100 Amp and 480 VAC 1-phase, 2-wire service or as indicated on the plans.

Materials

The service drops shall be sized and equipped as shown on the Plans. Meter sockets shall be installed in accordance with the requirements of the utility. Grounding shall be in accordance with Standard Specification 807.12 and shall be part of the service installation.

The service drop or metered panel shall be a Service Entrance rated, NEMA 3R Load Center with integral meter base rated 120/240VAC similar to the GE TSM1610CSCU, Square D RC1624M100S, or Siemens MC2040B1150, or with a separate meter base when rated at 480VAC as indicated in the plans. The panel shall be equipped with a Main Circuit Breaker sized as indicated on the plans or sized for the service provided. Provide a minimum of sixteen, 1 inch, 1-pole circuit breaker spaces in the panel for branch circuits. The enclosure shall be padlockable.

Circuit breakers shall be single or two-pole as required by the branch circuit. Circuit breakers shall have a minimum 10,000 AIC for 240V circuit breakers, and 65,000 AIC for 480V circuit breakers. Panels shall be fully rated; series rated shall not be allowed.

Construction Requirements

The service point shall be installed at locations as indicated in the Plans and shall also be closely coordinated with the utility's requirements. Work under this item includes overhead and underground service power drops. The Contractor shall pay for all costs required by the utility for service installation.

After coordination with the electric utility's representative, the Contractor shall submit a "Connection Request" form to the Department. The Department will forward this form to the electric utility and the Department will be responsible for paying bills after service is connected and the Contractor pays the utility bills for all construction costs. The Service drops shall be in accordance with these Special Provisions and with 807.15.

All electrical work associated with the service power drop installations shall be in accordance with the Plans, Standard Specifications, and the manufacturer's written instructions and applicable requirements of NEC standards. As identified in the plans or per the Engineer request, where the proposed service point is more than 500 ft. from the ATMS remote site, a separate, lockable, subpanel shall be provided at the ATMS site.

All subpanels shall have their own ground rod which is also connected to the site's grounding system. The grounding conductors and ground rod shall be bonded to all non-current carrying metal on the subpanel.

Any location that incurs a new customer set-up charge from the power

utility shall be considered as part of the installation. The installation is not complete until power is available at the service point site.

Method of Measurement

Service points will be measured for payment per unit each complete and in place. Circuit Breakers when identified as the method for power service connection to an existing ITS service point shall be measured for payment per unit each complete and in place.

Basis of Payment

Service Points shall be paid for at the contract unit price per each as follows:

Payment will be made under:

Pay Item	Pay Unit Symbol
Service Point, ATMS, Circuit Breaker	EACH
Service Point, ATMS, 120/240V, Overhead	EACH
Service Point, ATMS, 120/240V, Underground	EACH
Service Point, ATMS, Subpanel	EACH
Service Point, ATMS, Metered Panel	EACH

Terminations, connections, service conductors, circuit breakers when not identified as the power source to an existing ITS Service Point, ground rods, ground wires, fittings, switches, service cabinets, utility current transformer cabinets, PT cabinets, CT cabinets, weatherheads, meter sockets, cables, conduits down to first below grade bend, poles, aluminum channels, braces, and mounting surfaces, and other miscellaneous items shall be incidental to this work and no separate payment will be made. Utility charges that are a standard fee for new service installations are incidental to this work, except as provided below.

The cost of the ground rod for a subpanel location shall be considered incidental to the cost of the subpanel.

Padlocks are to be in accordance with the padlock specification and are paid for separately.

ATMS TRACER WIRE

Description

Work under this item shall include furnishing and installing tracer wire in conduits as shown on the plans and as described in these specifications to assist with conduit locates.

Materials

Tracer wires shall be a single conductor, high strength copper clad steel, orange color jacket, high molecular weight and high-density polyethylene (HMWPE) insulation, #12 AWG wire. The HMWPE jacket shall be a minimum of 30 millimeters in thickness. The wire shall have a minimum break load of 425 pounds and made of fully annealed, high carbon 1055 grade steel. Tracer wires shall be rated for use at 30 volts. Wire connectors shall be waterproof.

Construction Requirements

As determined by the Department, new continuous tracer wire shall be placed into each run of fiber optic cable, fiber optic trunk cable, fiber optic lateral cable and fiber optic extension cable from handhole to handhole or vault. A minimum of 3 ft. of tracer wire shall be securely tied off inside of a terminating handhole.

As determined by the Department, a new continuous tracer wire shall be provided in the same conduit with all fiber optic cables. Tracer wire is not required to be installed in above-ground conduits and empty conduits that are part of a duct bank that contains a non-dielectric (conductive) cable. When multiple cables are to be installed in a conduit, all cables shall be pulled simultaneously to prevent friction damage to the cable insulation. Spare and empty conduits shall not be utilized to install the tracer wire.

The tracer wire shall be securely fastened inside of the handhole or vault. A waterproof wire nut or direct burial connector shall be connected to each end of the tracer wire to prevent corrosion. At vaults with splice enclosures the tracer wire shall be connected to the enclosure and connect to the wire lead for the Fiber Optic, Locator Post.

Method of Measurement

ITS, Tracer Wire will be measured for payment per linear ft. of materials provided complete and in place.

Basis of Payment

ITS, Tracer Wire will be paid at the contract unit price per linear ft., complete and in place.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS, Tracer Wire	LFT

The cost of materials, labor, equipment, and necessary incidentals are included in the cost of this work. ITS, Tracer Wire shall include fasteners, waterproof wire nuts, waterproof direct burial rated connectors and all other incidentals necessary for installation. Waterproof wire nuts or connectors shall be considered incidental to the cost of the tracer wire.

CABLE DUCT MARKER

Description
This work shall consist of providing ATMS cable duct markers as shown on the Plans and as directed by the Engineer.

Materials
Concrete Markers:
Concrete cable duct markers shall be manufactured and installed according to the Standard Specifications 807.08 except as revised herein. Concrete cable duct markers shall be marked "ATMS" with field-cut arrows identifying the direction of the underground conduits.

Flexible Markers:
Flexible cable duct markers shall be manufactured of an integrally colored orange, single piece, two-sided, UV resistant, fiberglass reinforced composite, constructed of adequate strength and rigidity to enable installation into compacted soil.

Markers shall be capable of returning to vertical and remaining functional after being subjected to a head-on vehicle impact. At a minimum, markers shall be 3.75 inches wide by 66 inches long with raised and reinforced ribs along each side to protect the decal. Decals shall be provided on both sides of the markers. Decal shall consist of a standard fiber optic warning message, visible from a distance, such as "Warning Fiber Optic Cable". In addition, the decal shall include the message "Call INDOT Technology Deployment Technicians Supervisor before Digging 317899-8606" along with the Department symbol (digital image is available on the Department's website):

Figure A: Department's Logo

All markers and decals shall be from a single manufacturer. Decals shall be considered incidental to the cost of the flexible markers.

Markers shall be installed according to the manufacturer's recommendations, or to a depth suitable to resist the impact of wind or an errant vehicle without pulling free. Location of marker installations shall be as shown on plans or as determined by the Department.

Method of measurement
The completed work as described for cable duct marker will be measured by the unit of EACH and includes furnishing and installing of a cable duct marker with all accessories necessary for a complete installation.

Basis of Payment

Payment for the work included in this special provision will be paid for at the Contract unit price per EACH.

Payment will be made under:

Pay Item	Pay Unit Symbol
Cable–Duct Marker, Concrete	EACH
Cable–Duct Marker, Flexible	EACH

The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.

CCTV ASSEMBLY

Description

This work shall consist of furnishing and installing closed circuit television cameras and camera lowering systems.

The CCTV assembly shall have the following components:

1. One camera with pan-tilt-zoom (PTZ)
2. One camera lowering system

Materials

Camera shall, at a minimum, meet the following characteristics:

CAMERA

• Sensor	1/2.8" CMOS
• Scanning	Progressive
• Resolution	1,920 x 1,080 640 x 360 @ 3x dig. Zoom
• Digital Formats BT.1120, 1080p,	YUV 4:2:2 SMPTE 274M, BT.709, 1080i, 720p
• Frame Rate	30 fps
• Camera Format	Day/Night (IR Cut Filter)
• Day/Night Modes	Auto, Color, B/W
• S/N Ratio	>50 db
• Motion Detection	Off/On [Area of Detection]

SENSITIVITY

• Standard	(f1.4, 1/30, 30 IRE)
o Color	0.25 lux (0.025 fc)
o B/W	0.024 lux (0.0024 fc)
• Digital Slow Shutter	(f1.4, 1/2, 30 IRE)
o Color	0.015 lux (0.0015 fc)
o B/W	0.0015 lux (0.00015 fc)

OPTICS

• Zoom Lens zoom	30x, 4.4 to 132mm effective 264mm with 2x digital
• Aperture	f1.4 -> f4.6
• HAFOV	63.4° to 2.1° @ 1920x1080 63.4° to 0.7° @ 640 x 360
• Focus	Auto/Manual [Near, Far]
• Focus Search	Normal, Bright, Point Source
• Focus Sensitivity	Low, Normal, High
• Iris	Auto/Manual [Open/Close]
• Lens Speed	Three [Slow, Medium, Fast]
• Digital Zoom	12x, Off/On [Depth]

IMAGE PROCESSING

• Defog Mode Strength and Color	Off/Auto/Manual [3 Levels,

	Adj.]
• Image Stabilization	Off/On
• Enhanced Intensity	Off, Enhanced, Whiteout Reduction
• Dynamic Range Combo, Contrast]	>90dB Off/On [3 Levels, Normal,
• Back Light Comp	Off/On [Level Setting]
• Shutter (AES)	Auto/Manual [1/2 -> 1/30,000]
• Slow Shutter Setting	Off/On [1/15->1/2] with Limit
• White Balance	Auto/Manual [Red/Blue Adjustment]
• (WB) Modes	Normal, Mercury, Sodium Vapor
• AGC	1 to 48db, Adjustable
• Sharpness	Soft, Normal, Sharp, Sharpest
• Noise Reduction	Normal, Medium, Strong, Fixed

IP STREAM

• Video Streams on available	5 or more video streams dependent
	processing budget
• Video Codec Profiles, MJPEG	H.264 Base, Main and High
• Video Protocols	RTSP/RTP RTSP Interleave HTTP Tunneling RTP Multicast
• Video Resolution	1080p, 720p, D1, VGA, CIF
• Video Frame Rate	1 to 30 fps, 30 fps default
• Video Data Rate	256Kbs to 8Mbs
• Video Rate Cntrl	Variable or Constant
• Video GOV	1 to 600, 30 default
• Video Latency	Four frames (0.133 sec.)
• Video Trans.	99.999% error free

NETWORK INTERFACE

• Network Format sensing, full duplex	802.3u 100Base-T, MDI-X auto-
• Network Protocol IGMPv2/v3, DHCP, RTP,	TCP, UDP, IPv4, ICMP, DNS,
	RTSP, RTCP, NTP, HTTP, SOAP, HTTPS
ARP, FTP, SMTP,	SNMP/NTCIP, Telnet. ONVIF Profile
S	
• Media Players player compliant with	VLC, Quick Time or any media
	RFC 2326, 3984, 3550, 2435,
ISO/IEC 13818-1	
• ONVIF	Profile S
• Camera Protocols legacy	ONVIF, NTCIP 1205, CohuT, CohuHD
• Security Anonymous [User	4 Levels: Admin, Operator, User,

	Name + Password], Digest Authentication
• Updates camera web server	File upload over network using Interface
• Configurations	Stored in Non-Volitiale Memory
• Browsers	IE11, Firefox, Chrome
DIGITAL I/O INTERFACE	
• Digital Circuits defined as either	Four digital I/O circuits, user input or output
ANALOG INTERFACE	
• Video Format	NTSC or PAL
• Serial PTZ 115k baud bit	RS422, full/half duplex, 1,200 to adjustment, data, stop and parity configuration.
• Protocols NTCIP 1205, A/D,	CohuHD Legacy, PelcoD, Ultrak, FAST, Javelin
COMMAND CORE ACTION ENGINE	
• Input Triggers Scheduler, Preset User command	Digital Input(s), Timer, reached, PTZ move, Maintenance,
• Output Actions image, Send Email, Tour, Display OSD	Activate digital output(s), FTP Send Text, Activate Preset or Message
• Trigger Queuing output actions by last in.	User selectable mode. Processes trigger priority, first in, or
• Servers be configured	Multiple FTP and EMAIL servers can for use by camera system
ON SCREEN DISPLAY (OSD)	
• OSD Capacity selected for display	Up to 7 OSD Elements can be on video
• OSD Elements Date/Time,	Text, Preset, Position, Compass, Sector, Maintenance, Action Event
• OSD Characters element	Up to 40 characters per text
• OSD Size	20 to 90 point, Increment of 10
• OSD Color	White, Black, Green, Red, Blue
• OSD Background	Transparant, Black

- OSD Location — Upper Right/Left, Lower Right/Left, Center, Custom
- Banner Display — On/Off, Top/Bottom, 4 OSD elements
- Logo Display — BMP, PNG, GIF Format, [x,y] position, Transparancy

PRIVACY MASKS

- Capacity — Up to 8 Rectangular Masks.
- Color — Red, orange, green, blue, purple, grey
- Blur — Solid, fine, medium or coarse pixelated
- Opacity — 25, 50 or 75%
- Brightness — 4 levels of adjustment

POSITIONING DRIVE

- Pan Range — 360° continuous rotation
- Tilt Range — 360°
- Preset Speed — Peak speed of 120°/sec 180° movement < 3 seconds
- Manual Speed — 0.1° to 45°/second
- Speed Resolution — > 64 Variable speed levels
- Repeatability — +/- 0.05°
- Resolution — +/- 0.05°
- Presets — Up to 256, Includes pan, tilt, zoom, focus, preset ID, I/O output state
- Tours — Up to 256, Includes presets with dwell, speed, direction and recurrence properties
- Auto Park — Returns to a preset or tour after timer expires, Timer Value [Off, 1 Minute to 999 Hours]
- Features — Auto focus/iris on PTZ, Proportional PTZ, Video freeze on preset, High wind/vibration mode, Set north calibration, Inverted mounting mode

ELECTRICAL

- Input Voltage — PoE++, 24Vac or 120Vac, model dependent
- Power — 30w, up to 60w with heaters ON
- Voltage Range — NEMA standard TS 2-2003 section 2.2.7 tests C to H
- Transient/Surge — Certified to CISPR 24 levels
- Emissions — Certified to CISPR 22 levels
- Pigtail Cable(s) — Approx. 24”

MECHANICAL

- Weight — 21.5 pounds (9.75 kg maximum
- Dimensions — Refer to dim. diagram
- Construction — Powder Coated aluminum
- Faceplate — Optically Correct Glass
- Faceplate Wiper Time Out — Model Dependent, [On/Off, Dwell, Settings]
- Sunshield — Included as standard
- Inverted Mounting — Yes. Software selectable
- Connectors — RJ45, AMP, MS, Model dependent
- Color GR142 — Light Gray Cardinal Coating T241-

ENVIRONMENTAL

- Protection Rating — Camera – IP68, Pressurized with Dry Nitrogen, 3.5 psi. Positioner Body – IP66
- Operating Temp NEMA TS2 2.2.7 — -40°F to 167°F (-40°C to 75°C) Per
- Heaters for managing camera system. The glass designed to — Heaters are software controlled proper internal temperature of faceplate heater is ITO coated maintain outer faceplate surface temperture above 32° (0°C) down to – 4°(– 20C)
- Humidity — Up to 100%
- Vibration sweep @ 0.5g perpendicular — Per NEMA TS2 para. 2.2.8. 5-30Hz applied in each of 3 mutually planes.
- Shock applied in each of 3 — Per NEMA TS2 para. 2.2.9. 10g mutually perpendicular planes
- Corrosion Paragraph 4.5.2, ANSI — MIL-STD-810G, Method 509.5, NCSL Z540-1, ISO 17025:2005
- Impact Rating — IK10

EMC CERTIFICATIONS

- CE, FCC Part 15B, RoHS
- AS/NZS CISPR 22:2009+A1:2010
- CAN/CSA-CISPR 22-10
- EN 55022:2010+AC: 2011
- EN 55024:2010
- EN 61000-3-2:2006+A1:2009+A2:2009
- EN 61000-3-3:2013
- EN 61000-4-2: 2009

- EN 61000-4-3: 2006 +A1:2008 +A2:2010
- EN 61000-4-4: 2004
- EN 61000-4-5: 2006
- EN 61000-4-6: 2009
- EN 61000-4-8: 2010
- EN 61000-4-11: 2004

Construction Requirements

All installation services shall comply with all manufacturer's instructions and warranty provisions and warranty contract maintenance services and Department electrical codes. All wiring entry to the camera dome shall use watertight fittings. All materials shall be installed in a neat and professional manner. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices.

The camera lowering system shall be designed to support and lower a standard closed-circuit television camera, lens, housing, PTZ mechanism, cabling, connectors, and other supporting components without damage or causing degradation of camera operations. The camera lowering device and the tower are interdependent upon each other and thus, must be considered a single unit or system. The lowering system shall consist of a coax contact unit, self-aligning divided support arm, an adapter for attachment to a tower, and a camera connection box. The divided support arm and receiver brackets shall be designed to self-align the contact unit during installation and ensure the contact unit cannot twist under high wind conditions. The camera-lowering device shall withstand wind forces of 100 mph with a 30 percent gust factor using a 1.65 safety factor. The lowering device shall effectively operate within a temperature range of -40 to 191°F. The lowering device manufacturer shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum effective projected area (EPA), the actual EPA or an EPA greater than that of the camera system to be attached. If the camera-lowering device is not from the Department Approved Materials List, the camera-lowering device to be furnished shall be the product of manufacturers with a minimum of 2 years of experience in the successful manufacturing of such systems. The lowering device provider shall be able to identify a minimum of 3 previous projects where the purposed system has been installed successfully.

All pulleys for the camera lowering tool shall have sealed, self-lubricated bearings, oil tight bronze bearing, or sintered bronze bushings. The lowering cable shall be a minimum 1/8-inch-diameter stainless steel aircraft cable with a minimum breaking strength of 1,740 pounds with seven strands of 19 gauge wire each.

The camera lowering system shall be capable of lowering the camera to the ground without contacting the pole/tower structure or anything attached to the tower structure. A guide cable shall be provided to prevent interference with the tower structure. The guide cable shall be 5/32 inch diameter stainless steel and shall be a manufacturer provided component. The cable guide shall be installed

per manufacturer's recommendations. The guide cable shall be mounted to minimize the impact on the camera's view of the roadway, and shall have the ability to be disconnected from the ground mounting point to maximize the camera's view.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct 56,000 bps RS422/485 or RS-232 data and one volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The interface and locking components shall be made of stainless steel and/or aluminum. All external components of the lowering device shall be made of corrosion-resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment. A weephole with screen shall be included on the underside of the weight box.

The lowering system shall include the following basic components:

- Coaxial contact unit
- Self-aligning divided support arm
- Adapter for attachment to tower
- CCTV control cable junction box at the top of the tower
- Permanent mount lowering tool

The suspension contact unit shall have a load capacity 200 pounds with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and movable components of the lowering device. The movable assembly shall have a minimum of two latches. This latching mechanism shall securely hold the device and its mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy-duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof, with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. Contractor shall supply a means of separating the power and video cabling from the lowering cable if required by the Design Documents or Engineer. The only cable permitted to move during lowering or raising shall be the stainless steel lowering cable. All other cables shall remain stable and secure during lowering and raising operations.

The coax connector block consists of DIN Housing containing thermoplastic insulation bodies that hold the individual contacts. Guide pins and guide bushings shall prevent misconnections and provide accurate mating without relying on the contact pins to

provide alignment. There shall be a minimum of 12 –.06–in. contacts and 1–75 Ohm contact. The max current rating for each pin shall be at least 13 amps. The signal and power wires shall be crimped using an industry standard 8–point crimp tool. The video cable shall be 75 ohm coax not to exceed a length of 1,000 feet. The cable loss with the connectors shall not exceed 0.8 decibels per 100 feet at 5 megahertz. The camera cable shall be made up with the coax connector block in the factory and sealed with electrical insulating. The entire coax connector block shall be sealed from external dust and moisture when in the mated condition by means of a gasket.

The divided support arm and receiver brackets shall be designed to self–align the contact unit during installation and ensure the contact unit cannot twist under high wind conditions.

The camera–lowering device shall be operated by use of a permanent mount lowering tool. The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The clutch mechanism, but not the portable drill, shall be provided for each site. The lowering tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The lowering tool shall be made of durable and corrosion–resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry– accepted coating to withstand exposure to a corrosive environment. Lowering tool shall be installed in the stainless steel, or aluminum enclosure, rated 3R, mounted to the tower.

The Camera Lowering System shall be installed in accordance with the manufacturer's instructions. All materials shall be installed in a neat and professional manner. All installation services shall comply with all warranty provisions and warranty contract maintenance services. All installation services shall comply with all local and state electrical codes, and Motorola R–56 requirements. Installation of the Camera Lowering System shall be coordinated with INDOT to determine actual mounting height and azimuth. Typically, the camera lowering system azimuth will be perpendicular to the mainline lanes.

Prior to the delivery of the camera lowering system, the manufacturer will test for the following:

- Electrical continuity
- Direct connectivity to ground for an open circuit of 120 volts

The results of these tests will be supplied to INDOT with each camera lowering system upon delivery.

Contractor shall provide a 916.02(c) Type C certification from the vendor verifying the CCTV control cable was properly installed and tested before delivery to Contractor.

Contractor shall provide a manufacturer's warranty against defects in material and workmanship for a period of three years after Final Acceptance of each complete installation. Contractor shall include labor for removal and reinstallation of a failed unit. Warranty shall include lifetime warranty on water ingress into camera head enclosure.

Method of measurement
CCTV Assembly will be measured by the number of units installed.

Basis of payment
CCTV Assembly will be paid for at the contract unit price per EACH.

Payment will be made under:

Pay Item	Pay Unit Symbol
CCTV Assembly	EACH

The cost of all labor, materials, design, vendor support, and items necessary to provide a complete and functioning CCTV assembly shall be included in the cost of CCTV assembly.

FIBER OPTIC BACKBONE CABLE

Description
The Contractor shall provide outdoor-rated, single-mode, armored, fiber optic cable of the number of fibers specified as shown on the plans and as directed by the Engineer. Other ancillary components required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, fan-out kits, etc., shall be incidental to the fiber optic cable item and will not be paid for separately.

Materials
The single-mode, fiber optic cable shall incorporate a single tube, 12-fiber ribbon design or a loose, buffer tube design. The cable shall conform to the requirements of Rural Utility Service (RUS) 7 CFR 1755.900 (PE-90) for a single sheathed, armored cable, and shall be new, unused, and of current design and manufacture. The number of fibers in each cable shall be as specified on the plans.

Minimum Bending Radius:
The cable shall be capable of withstanding a minimum-bending radius of fifteen (15) times its outer diameter during operation and ten (10) times its outer diameter during installation without changing the characteristics of the optical fibers.

Environmental Requirements:
The cable shall meet all of the specified requirements under the following conditions:

1. Shipping/storage temperature: -40°F to +158°F (-50°C to +70°C)
2. Installation temperature: -30°F to +158°F (-30°C to +70°C)
3. Operating temperature: -40°F to +158°F (-40°C to +70°C)
4. Relative humidity from 0% to 95%, non-condensing

All backbone cables shall be suitable for installation in outdoor handholes, manholes, or vaults subject to immersion in water and ice.

Construction Requirements

Experience Requirements:

Personnel involved in the installation, splicing, and testing of the fiber optic cables shall meet the following requirements:

1. Shall have installed two systems where fiber optic cables are outdoors in conduit and where the systems have been in continuous satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses, and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.
2. A minimum of three years of experience in the installation of fiber optic cables, including fusion splicing, terminating, and testing single mode fibers.
3. Shall have installed one fiber optic cable system (which may be one of the two in the preceding paragraph), which the Contractor can arrange for demonstration to the Department representatives and the Engineer, if requested.
4. Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include knowledge of splicing procedures for the fusion splicer being used on this project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Contractor shall submit documented procedures to the Engineer for approval and to be used by Construction inspectors.
5. Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used in fiber optic cable testing procedures. Proof of this training shall be submitted to the Engineer for approval. In addition, the Contractor shall submit documentation of the testing procedures for approval by the Engineer.

Installation in Conduit:

The Contractor shall provide a cable-pulling plan, identifying where the cable will enter the underground system and the direction of pull. This plan shall address locations where the cable is pulled out of a handhole, coiled in a figure eight, and pulled back into the handhole. The plan shall address the physical protection of the cable during installation and during periods of downtime. The cable-pulling plan shall be provided to the Engineer for approval a minimum of 10 working days prior to the start of installation. The Engineer's approval shall be for the installation operation on the freeway and does not include an endorsement of the proposed procedures. The Contractor is responsible for the technical adequacy of the proposed procedures.

During cable pulling operations, the Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and pulling operations. Entry guide chutes shall be used and the ends of the conduit shall be fitted with bells to protect and guide the cable into the handhole conduit ports. Bells shall be removed after installation of the cable. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

The pulling tension shall be continuously measured and shall not be

allowed to exceed the maximum tension specified by the manufacturer of the cable. Fuse links and breaks can be used to ensure that the cable tensile strength is not exceeded. The pulling system shall have an audible alarm that sounds whenever a pre-selected tension level is reached. Tension levels shall be recorded continuously and shall be given to the Engineer upon request.

The number of handholes/manholes/vaults and their locations shall be as shown on the Plans, or as requested by the Engineer.

The cable shall be pulled into the conduit as a single component, absorbing the pulling force in all tension elements.

The steel strength member(s) and Aramid yarn shall be attached directly to the pulling eye during cable pulling. "Basket grip" or "Chinese-finger type" attachments, which only attach to the cable's outer jacket, shall not be permitted. A breakaway swivel, rated at 95% of the cable manufacturer's approved maximum tensile loading, shall be used on all pulls. When simultaneously pulling fiber optic cable with other cables, separate grooved rollers shall be used for each cable.

Three hundred (300) feet of slack fiber shall be installed at all location where splices are being made, one hundred and fifty (150) feet on each side of the splice enclosure and tie-wrapped and coiled as indicated on the plans. Fifty (50) feet of slack fiber shall be included at all other handholes or vaults not containing splices. Slack cable shall be pulled from the adjacent cabinet or shelter after installation and secured inside of the vault.

Construction Documentation Requirements:

Installation Practices for Outdoor Fiber Optic Cable Systems: The Contractor shall examine the proposed cable plant design. At least one month prior to starting installation of the fiber optic cable plant, the Contractor shall prepare and submit to the Engineer for review and approval, ten (10) copies of the Contractor's "Installation Practices for Outdoor Fiber Optic Cable Systems" manual, or as required by the Engineer. This manual shall address the Contractor's proposed practices covering all aspects of the fiber optic cable plant. This submittal shall include all proposed procedures, list of installation equipment, and splicing and test equipment. Test and quality control procedures shall be detailed as well as procedures for corrective action.

Operation and Maintenance Documentation: After the fiber optic cable plant has been installed, ten (10) complete sets of Operation and Maintenance Documentation shall be provided, or as required by the Engineer. The documentation shall, as a minimum, include the following:

1. Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
2. Final copies of all approved test procedures.
3. Complete performance data of the cable plant showing the losses at each splice location and each terminal connector.
4. Complete parts list including names of vendors.

Testing Requirements: The Contractor shall submit detailed test procedures for approval by the Engineer. All fibers shall be tested bi-directionally at both 1310 nm and 1550 nm with both an Optical Time Domain Reflectometer (OTDR) and a power meter and optical source. Any discrepancies

between the measured results and these specifications shall be resolved to the satisfaction of the Engineer.

A Certified Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter shall conduct the installation test. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

The Contractor shall provide the date, time, and location of any tests required by this specification to the Engineer at least 5 days before performing the test. Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers for continuity, events above 0.1 dB, and total attenuation of the cable. The test procedure shall be as follows:

Optical Time Domain Reflectometer: The method of connectivity between the OTDR and the cable shall be a factory patch cord or launch cable of a length equal to the "dead zone" of the OTDR. Optionally, the Technician can use a factory "fiber box" of 328 ft (100 m) minimum with no splices within the box. The tests shall be conducted at 1310 nm and 1550 nm for all fibers.

At the completion of the test, the Contractor shall provide two copies of documentation of the test results along with a Comma Separated File(CSV) to the Project Engineer. The test documentation shall be bound and shall include the following:

1. Cable & Fiber Identification:
    a. Cable ID
    b. Cable Location beginning point
    c. Cable Location end point
    d. Fiber ID
    e. Rube/Ribbon Color
    f. Fiber color
2. Operator Name
3. Date & Time
4. Setup Parameters
5. Wavelength
6. Pulse width (OTDR)
7. Refractory index (OTDR)
8. Range (OTDR)
9. Scale (OTDR)
10. Setup Option chosen to pass OTDR “dead zone”
11. Test Results:
    a. OTDR Test
    b. Total Fiber Trace
    c. Splice Loss/Gain
    d. Events > 0.10 dB
12. Physical Length (Cable Marking)
13. Fiber Length (OTDR)
14. Test results and traces shall also be provided on a CD or flash drive

15. Optical Source/Power Meter
16. Total Attenuation

These results shall be provided in tabular form. The following shall be the criteria for the acceptance of the cable:

1. The test results shall show that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss.
2. However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Contractor shall replace or repair the fiber including that event point.

The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows:

1. 0.5 dB/km at 1310 nm
2. 0.4 dB/km at 1550 nm

If the total loss exceeds these specifications, the Contractor shall replace or repair that cable run at the Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation shall require the replacement of the cable run at the Contractor's expense, including labor and materials.

The aforementioned tests shall be completed on the reel before installation and completed after the complete installation.

Splicing Requirements: Splices shall be made at locations shown on the Plans. Any other splices shall be permitted only with the written approval of the Engineer.

All optical fibers shall be spliced as indicated on the Plans. If no information is provided, mainline splices shall concatenate the fibers from the two cable segments, that is, the colors of the buffer tubes and fibers shall be the same across the splice. For splices that breakout the individual fibers, the fibers shall be spliced in accordance with the Plans.

Slack Storage of Fiber Optic Cables: As part of this item, slack fiber shall be supplied as necessary to allow splicing of the fiber optic cables to occur in a controlled environment, such as a splicing van or tent. After splicing has been completed, the slack fiber shall be stored underground in vaults.

Where identified on the plans or as directed by the Engineer, additional lengths of fiber shall be stored as maintenance coils. The aggregate lengths of the maintenance coils and the slack fiber shall be used to repair and maintain the fiber optic cable.

Label the destination of each cable in each handhole, vault. Label the destination of each cable at a fiber distribution panel (FDP) located in cabinets, DMSs, and shelters. As a minimum, FDP face plate shall indicate the destination (i.e. dms-465-022-0-nb).

Fiber optic cable shall be tagged inside handholes with a vinyl label containing the text: "CAUTION – FIBER OPTIC CABLE."

Identification of installed Fiber Optic Cables: The backbone fiber optic cable shall be labeled as “Destination (i.e. CDP-S2)” – “Route (i.e. 465)” –

"Destination (i.e. CDP-S3" and "Count" - "Fiber Type (SM or MM)" depending on the location of the fiber and type of fiber. Labels shall be permanent wrap-around type, machine printed and shall be installed within 2 feet from each installed splice enclosure, termination shelf, or conduit penetration into a handhole, cabinet or other structure.

Method of measurement

Fiber optic cable will be measured per foot of cable provided in conduit, handhole, vault, cabinet, or shelter.

Basis of payment

Fiber optic cable will be paid at the contract unit price per lineal foot. Payment will be made under:

Pay Item	**Pay Unit Symbol**
Fiber Optic Cable, Armored, 24F Single Mode	LFT
Fiber Optic Cable, Armored, 96F Single Mode	LFT

The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item. The bid price shall include all necessary preparation work, pulling equipment and materials, testing, labor, and incidentals necessary to complete the work.

FIBER OPTIC CABLE SPLICE

Description

The Contractor shall splice optical fibers from different cable sheaths and protect them with a splice enclosure and splice trays at the locations shown on the Plans. Fiber splicing consists of in-line fusion splices for all fibers described in the cable plan at the particular location.

Materials

Splice Enclosures: Splice Enclosures shall be designed for use under the most severe conditions such as moisture, vibration, impact, cable stress, and flex temperature extremes as demonstrated by successfully passing the factory test procedures and minimum specifications listed below:

Physical Requirements: The enclosures shall provide ingress for up to four cables in a butt configuration. The closure shall prevent the intrusion of water without the use of encapsulates.

The enclosure shall be capable of accommodating splice organizer trays that accept mechanical or fusion splices. The splice enclosure shall have provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or un-spliced fiber. Splice organizers shall be re-enterable. The splice case shall be UL rated.

Enclosure re-entry and subsequent reassembly shall not require specialized tools or equipment. Further, these operations shall not require the use of additional parts.

The splice enclosure shall have provisions for controlling the bend radius of individual fibers to a minimum of 1.5 in (38 mm).

For splices in armored cables, the splice closure shall provide a method of bonding the armor from all sheaths entering the closure. It shall also provide a means of grounding the armor and closure at the splice location.

Factory Testing:
Factory Testing shall conform to the following testing;

Compression Test:
The closure shall not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 1335 N at a temperature of 0° F and 100°F (-18°C and 38°C). The test shall be performed after stabilizing at the required temperature for a minimum of two hours. It shall consist of placing an assembled closure between two flat parallel surfaces, with the longest closure dimension parallel to the surfaces. The weight shall be placed on the upper surface for a minimum of 15 minutes. The measurement shall then be taken with weight in place.

Impact Test:
The assembled closure shall be capable of withstanding an impact of 28 N-M at temperatures of 0° F and 100° F (-18° C and 38° C). The test shall be performed after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 20 lb (9 kg) cylindrical steel impacting head with a 2 in (5 cm) spherical radius at the point where it contacts the closure. It shall be dropped from a height of 12 in (30 cm). The closure shall not exhibit any cracks or fractures to the housing that would

preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

Cable Gripping and Sealing Testing:

The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber @ 1550 nm when attached to the cables and the closure assembly. The test shall consist of measurements from six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. The measurements shall be taken from the test fibers before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

Vibration Test:

The splice organizers shall securely hold the fiber splices and store the excess fiber. The fiber splice organizers and splice retaining hardware shall be tested per EIA Standard FOTP-II, Test Condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

Water Immersion Test:

The closure shall be capable of preventing a 10 ft. water head from intruding into the splice compartment for a period of seven days. Testing of the splice closure will be accomplished by placing the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Continuous pressure shall be applied to the vessel to maintain a hydrostatic head equivalent to 10 ft. on the closure and cable. This process shall be continued for 30 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

Certification:

It is the responsibility of the Contractor to ensure that either the manufacturer, or an independent testing laboratory has performed all of the above tests, and the appropriate documentation has been submitted to the Department. Manufacturer certification is required for the model of closure supplied. It is not necessary to subject each supplied closure to the actual tests described herein.

Construction Requirements

Installation: Underground splice enclosures shall be installed in ATMS Vaults at locations shown on the plans. After all necessary splices are made and the enclosure is sealed, the Contractor shall install the enclosure in the vault such that it is supported at least one ft. above the aggregate bottom of the vault. The Contractor shall use appropriate hardware for mounting. The Contractor shall seal the splice closure and pressure test it following the manufacturer's instructions. Dry water-blocking compound shall be placed in the closure during this process.

The Contractor shall secure the Splice Closure to the side of the splice facility using cable support brackets or similar methods. All cables shall be properly dressed and secured to rails or racks within the vault. No cables or enclosures will be allowed to lie on the floor of the splice facility. Cables that are spliced inside a building shall be secured to the equipment racks or walls as appropriate and indicated on the Plans.

The enclosure shall be installed according to the manufacturer's

recommended guidelines.

The Contractor shall prepare the cables and fibers in accordance with the enclosure and cable manufacturers' installation practices. A copy of these practices shall be provided to the Engineer 21 days prior to splicing operations.

Using a fusion splicer, the Contractor shall optimize the alignment of the fibers and fuse them together. The Contractor shall recoat the fused fibers and install mechanical protection over them.

Upon completing all splicing operations for a cable run, the Contractor shall measure the mean bi-directional loss at each splice using an Optical Time Domain Reflectometer. This loss shall not exceed 0.1 dB.

The Contractor shall measure the end-to-end attenuation of each fiber, from connector to connector, using an optical power meter and source. This loss shall be measured from both directions and shall not exceed 0.5 dB per installed kilometer of single mode cable, measured at 1310 nm.

The test results shall be supplied to the Department in hard copy and electronic versions.

The cable installation shall satisfy the requirements of both the National Electric Code (NFPA-70-2008) and the National Electric Safety Code (IEEE C2-2007). The standards require that the armor be bonded and grounded any time that the armor is interrupted or exposed by opening the sheath. These documents also provide minimum separations from foreign utilities.

For splices in armored cables, the Contractor shall ground the splice closure using a #6 AWG conductor or equivalent.

As directed by the Engineer, the Contractor at no additional cost to the Department shall replace any cable splice not satisfying the required objectives.

Method of measurement

Fiber optic fusion splices will be measured for payment per each spliced fiber strand, furnished, installed and tested.

Splice enclosures will be measured for payment per each enclosure furnished, installed and secured to the wall of the splice facility.

No additional payment will be made for pulling slack fiber optic cable from nearby vaults, as required to complete a fiber optic splice. The cost of pulling slack cable shall be included in the bid price of the fiber optic splice.

Basis of payment

Fiber optic fusion splices will be paid for at the contract unit price per each fiber optic strand spliced, complete and in place. Fiber optic splice enclosures will be paid for at the contract unit price per EACH.

Payment will be made under:

Pay Item	Pay Unit Symbol

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          Fiber Optic, Fusion Splice.............................EACH
          Fiber Optic, Splice Enclosure .........................EACH
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The unit prices include, as a minimum, all testing and performance verification as described herein, and any incidentals necessary to complete the

FIBER OPTIC DROP CABLE

Description

The fiber optic drop cable is used for installing fiber optic cable into Intelligent Transportation System (ITS) control cabinets and relay shelters. This ITS Drop Cable is used for connectivity between a primary fiber trunk, or feeder cable, and various field devices such as closed circuit television cameras at field locations as shown on the Plans.

Material requirements

The Fiber Optic ITS Drop Cable shall include a pre-terminated, pre-tested connector module with pigtails that splice into the primary fiber trunk. This connector module mounts into the ITS field cabinet enclosure or on a standard 19-inch rack rail. The fiber optic ITS drop cable shall have the following specifications: 1. Single mode 2. Fiber count – 6 fiber 3. Connector #1 – SC (pre-terminated) 4. Connector #2 – Pigtail length of 150’ 5. mounting plate for cabinet rack 6. Insertion Loss — .2 dB typical 7. Return Loss — > -40 dB SPC 8. Tensile Strength – 50lbs. (220N) <.20 dB change 9. Temperature Cycling – -40°C + 70°C, 40 cycles <.20 dB change 10. Ferrule material— Ceramic 11. Housing material — Acrylic, UL94V0 INSTALLATION REQUIRMENTS. Coordinate layout and installation of fiber optic drop cable with other installations. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Engineer.

Method of Measurement and basis of payment

All fiber optic drop cables will be measured for payment per unit each delivered and after demonstration of performance.

Fiber optic drop cables will be paid for at the contract unit price per each as follows: x “FIBER OPTIC ITS DROP CABLE ASSEMBLY, 6 FIBER”

FIBER OPTIC LOCATOR POST

Description

The Contractor shall furnish Fiber Optic Locator Post for identifying locations of fiber optic cable as shown on the plans or as directed by the Engineer.

Material

The Fiber Optic Locator Post shall be made of a non-conductive, high-density polymer, and shall be integrally white in color with an orange cap with black graphic and lettering on two sides. All colors shall be stabilized against ultraviolet light such that they will not fade under continuous exposure to direct sunlight. The marker shall retain dimensional stability in temperatures ranging between -40° F and 175° F. Each post shall be able to withstand a single vehicle impact at 45 MPH and return to within 10 degrees of vertical within 60 seconds.

Installation

A Locator Post shall be installed at fiber optic splice locations. At splice points, posts shall be connected to the fiber splice cases and the armored cable with a #12 ITS, Tracer Wire in innerduct as indicated on the Plans.

Locator Posts shall be installed in accordance with the manufacturer specifications and details.

Locator Posts shall be installed at the same time or immediately after the installation of underground conduits and vaults for identification of underground infrastructure.

Method of Measurement

This work will be measured in units of each for the number of markers that are placed and accepted.

Basis of Payment

Payment will be made per each for Fiber Optic, Locator Post at locations as shown on the plans or as approved by the Engineer.

Payment will be considered full compensation for all work, materials and equipment required to place the markers at the locations shown on the plans, details, or as directed by the Engineer.

Pay Item	**Pay Unit Symbol**
Fiber Optic, Locator Post	EACH

The cost of materials, #12 tracer wire between the vault and post, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.

FIBER OPTIC PATCH PANEL ASSEMBLY

Description

This work shall consist of furnishing and installing patch panels for terminations inside of the communications shelter or ITS Cabinet.

Materials

The patch panel shall have brackets and all other hardware required for rack mounting in an EIA standard 19-in. equipment rack, or wall mounted if required as shown on the plans. The enclosure shall take up no more than four rack units for 96 fiber panels and no more than one rack unit for 12 fiber panels. The patch panel shall be made of powder-coated aluminum.

The enclosure shall include routing guides for jumpers, strain relief for pigtails coming from a splice enclosure, and labels for every connector. The panel shall route fiber optic patch cables between any two connectors without reaching the patch cables' minimum bending radius.

Twelve Port Panels

The enclosure shall include a 12 port patch panel cassette module with a male connection MPO, Type A, IP 69k and 68 for connection to the trunk cable and SC connectors on the front panel. The patch panel cassette shall be pre-terminated from the factory between the SC connectors and the MPO connector. Each MPO connector shall not cause in excess of 0.65dB optical signal loss when tested at 1310nm with a typical loss of 0.35dB. Each SC connector on shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold cassettes totaling at least 36 connectors or as shown on the plans. Provide enough cassettes for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with cassettes or patch panels.

Ninety-six Port Panels

The enclosure shall include patch panel modules with SC connectors. Each SC connector on the panel shall not cause in excess of 0.3dB optical signal loss when tested at 1310nm. The enclosure shall be designed to hold modules totaling at least 96 connectors in a vertical array mountable in a 19 inch rack. Provide enough modules for every fiber that terminates in the enclosure. Provide blank panels for panel positions that are not equipped with patch panels.

Construction Requirements

Contractor shall provide all equipment for fusion splices, pig tails, trays for organizing equipment, break out kits, connectors, labels, and other accessories required to make a complete system. All fibers shall be terminated into the patch panel assembly in either a communications shelter or cabinet location. The cost of terminations shall be included in the patch panel assembly price.

Method of Measurement

Fiber optic patch panels shall be measured per each unit furnished and installed, which shall include the patch panel, appropriate mounting hardware, labor, and any other incidental materials necessary to complete the work.

Basis of Payment

Fiber optic patch panels will be paid for at the contract unit price each. Payment will be made under:

Pay Item	**Pay Unit Symbol**
Fiber Optic, Patch Panel Assembly, 96 Port	EACH
Fiber Optic, Patch Panel Assembly, 12 Port, 1U	EACH

The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.

HANDHOLES

SECTION 805.03, BEGIN LINE 30, INSERT AS FOLLOWS:
ATMS Handholes shall be as shown on the plans. The handhole covers shall be bolted into place with stainless steel bolts and washers. The cover frame shall be installed in the handhole with a butyl rubber sealant in tape/coil form for a proper seal between the handhole and frame and to prevent it from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants.
The cover for the ATMS handhole shall be marked with logo imprints of "Traffic Management System" or "Traffic Management Power" horizontally across the cover.
Covers labeled "Traffic Management Power" shall be provided whenever the handhole is used for power distribution cables.
Covers labeled "Traffic Management System" shall be provided in all other handholes.

Pay Item:
Handhole, ATMS .....EACH

ITS, CELLULAR MODEM ASSEMBLY

Description
The modem shall provide communication between the ITS Controller and the TMC.

Materials
The ITS, Cellular Modem shall consist of the following components:

1. One cellular modem gateway
   - CRADLEPOINT COR SERIES ROUTER MODEL # IBR900-1200
   - Direct wire GPIO cable
   - COR Extensibility Dock
   - Power Cables
   - 5 Year Warranty & Licensing
2. One, Five-in-one antenna
   - AG60 SERIES W/CABLE (2 X CELLULAR 3G/4G/LTE/GPS/2 X WiFi 2.4GHZ FOR CRADLEPOINT IBR900)

The ITS, Cellular Modem shall provide all the needed features and components to provide data communications between the ITS field cabinet and the Department Traffic Management Centers.

Construction Requirements
The ITS, Cellular Modem shall be installed in accordance with the manufacturer's instructions. All materials shall be installed in a neat and professional manner. All installation services will comply with all warranty provisions and warranty contract maintenance services in accordance with these specifications. All installation services shall comply with all local and state electrical codes, and Motorola R-56 requirements. All wiring entry and exits shall be made at the side or underneath components; no exposed top entry or exits are permitted. This requirement extends to all enclosures, junction boxes, support arms, or any other externally exposed devices. Cable termination shall be in accordance with the manufacturer's recommendations. Connectors outside of cabinets shall be sealed in accordance with the manufacturer's recommendations. The contractor shall de-burr all holes made in metal poles or cabinets and install grommets for cable protection.

Method of Measurement
The ITS, Cellular Modem will be measured for payment per the number of units furnished and installed complete and in place and after passing component and subsystem testing.

Basis of Payment
ITS, Cellular Modem will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS, Cellular Modem Assembly	EACH

The unit price includes the cellular gateway modem, cellular gateway modem power supply, antenna, cables, environmental enclosure, housing, mount, all mounting hardware, support arms, connections, Ethernet cables, and incidentals necessary to complete the work.

ITS FIELD SWITCH

Description

The Contractor shall provide and install the ITS field switch as described herein. The ITS field switch is used to connect communications equipment and the Aries Field Processor at ATMS sites and other sites as show on the plans. These switches must be compatible with the existing ATMS system architecture. Each switch shall be rack mountable. If the unit requires a rack mount kit or adapter which is not paid for elsewhere in these specifications, the kit shall be included with the ITS field switch at no additional cost to the department.

Materials

The Contractor shall provide the ITS field switch and rack mount kit conforming to the following specifications:

1. Extreme Networks ERS 3626GTS-PWR+

Construction Requirements

The Contractor shall provide and install the ITS Field switch in accordance with the manufacturer's instructions. Installation shall include all cables, mounting hardware, rack mount kit, power supplies with north American power cords and associated equipment required to mount and interface the communications subsystem. Installation activities are to be documented, including the output from show sys-info quantity, brand, model/part numbers, test results of all materials and devices used. Provide installer signed list of the materials installed with the required documentation. The contractor will follow assigned engineer's direction for configuration information of IP addresses VLAN settings naming convention port security SNMP settings. All cabling is to be labeled and dressed using hook & loop style straps to secure cables in cable management.

Method of Measurement

The ITS Field switch and rack mount kits shall be measured per the number of units furnished and installed, complete and in place and after passing component and subsystem testing. This includes the mounting hardware, rack mount kit, all cabling, power supplies, and incidentals necessary to complete the work.

Basis of Payment

The ITS Field switch will be paid for at the contract unit price per each installed complete and in place.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS, Field Switch, 3626GT-PWR+	EACH

The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.

ITS FOLDING POLE, CCTV

1. Description

This work shall consist of furnishing and installing folding intelligent transportation system, ITS, poles for closed circuit television, CCTV, cameras at the locations shown on the plans or as directed.

2. Materials

Materials shall be in accordance with 807.02 and as follows:

Concrete, Class A.....702
Conduit.....922.19
Reinforcing Bars.....910.01

The ITS pole structure material shall be in accordance with ASTM A 572, Gr 55. The base plate materials shall be in accordance with ASTM A36. Anchor bolt material for ITS pole structure shall be in accordance with ASTM F1554, Gr 55. Each anchor bolt shall be provided with two hex nuts and two washers with minimum 15 in. threaded end galvanized in accordance with ASTM A153. Structure shall be galvanized after fabrication in accordance with ASTM A123 or AASHTO M111. All connection hardware for the one upper sections shall be in accordance with ASTM A325. All other ITS pole shaft hardware, including hardware for the latch mechanism, shall be stainless steel in accordance with ASTM F593 or A594, type 304 or 305, except where otherwise specified.

(a) Design and Fabrication

The ITS folding poles shall be selected from the following manufacturers:

1. Valmont Industries, Inc.
   Omaha, NE 68154

2. Approved Equal

The ITS folding pole shall be designed and fabricated in accordance with the following criteria.

ITS approved equal pole shall be designed by a professional engineer. The Contractor shall submit two copies of signed and stamped plans and design calculations to the Engineer for approval. Working drawings for approved designs shall be in accordance with 105.02.

The folding poles shall be design in accordance with the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* with interim revisions through 2018. Other general material requirements include:

1. Number of Cameras. The folding poles with an effective mounting height of 55 ft shall have a maximum of three cameras installed at a maximum 2 ft from the pole center.

2. Foundations. The foundations for the folding poles shall be designed for the structure.

(b) Design Load

The folding poles shall be capable of supporting the following loadings:

1. Dead Load.
   The folding poles shall be capable of supporting the following dead loads.

Pole Height 55 ft		
Description of Load	Weight	Effective Projected Area
CCTV Cameras	285 lbs	7.5 sft
Lightning rod located at top of the pole top cover plate, located not to obstruct camera extension arm rotation.		
Self-Weight of the pole		

2. Wind Load.
   The folding poles shall be capable of supporting the following wind loads.

Wind Load Requirements	
Mean Recurrence Interval Risk Category	High
Wind Speed (1700 Year MRI Basic Wind Speed)	120 mph
Wind Speed (10 Year MRI Gust Wind Speed)	76 mph
Height and Exposure Factor, K_Z for height less than or equal to 33 ft	1.0
Gust Effect Factor, G	1.14
Design Service Life	50 years

3. Ice Load.
   The folding poles shall be capable of supporting an ice load of 3 lbs/sft applied to the full perimeter of all members and applied to one face of the signs. The folding poles shall be capable of supporting the specific load combination in the table below adapted from Table 3.4-1 in the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.*

Specific Load Combination Requirements				
Load Combination Limit State	Description	Dead Components (DC)	Wind (W)	Ice (IC)
Extreme II	Ice	Max 1.10/ Min 0.90	0.50*	1.0
***The wind load shall be based on the 120 mph basic wind speed.**				

4. Fatigue Load.
   The folding poles shall be capable of supporting a fatigue load in accordance with Article 11.5 of the 2015 edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* with a Fatigue Importance Factor, I_F, of 1.0.

5. Deflection Design Criteria:
   ITS folding poles shall be designed for 3 in. maximum pole top deflection at wind velocity of 30 mph with no gust.

ITS pole structure supports shall be an anchor base type pole structure and shall include a handholes and a pole top cover plate. The ITS pole shall be

either multisided, round or combination of multisided and round tubular members. Shroud handhole shall be located at 42 in., outside dimensions shall be 5.19 in. X 9 in. Winch handhole shall be located at 51 in., outside dimensions of the handhole shall be 7.5 in X 26.5 in. Opening for the handholes shall be reinforced to maintain the design strength of the pole. The handhole shall have a weatherproof gasket made of neoprene or silicone rubber. The gasket shall be formed for a fit around the handhole or be attached by mechanical means. The door and hinge shall be the same type of steel as the poles. The hinge pins and other securing hardware shall be stainless steel and tamperproof. The door shall be fabricated to allow for a padlock, which is not included in the hardware. The hasp used for padlocking shall be fabricated from stainless steel. The door shall be bolted shut and the padlock and key shall be provided to the Engineer. The door shall include a bug proof aperture with a minimum opening of 4 sq in. Two bonding plates shall be furnished which are accessible through the pole handhole for connecting the ground wires. A connection shall be furnished for an additional ground wire on the outside of the pole near the base plate.

After fabrication, the pole shall be cleaned and galvanized. Galvanized steel pole, including the handhole, handhole door, base plate mounting plates, and all other elements welded to the shaft shall be hot dip galvanized in accordance with ASTM A123 or AASHTO M 111.

Base Plate:
A one piece base plate shall be secured to the base of the pole and shall develop full strength of the pole. The base plate material shall be in accordance with ASTM A36. The 20 in. square baseplate shall be 2 in. thick. The diameter of bolt circle shall be 20 in. The base plate shall have four anchor bolt holes of size 1.75 in. diameter X 54 in. X 6in. (hook).

Anchor Bolts:
Ten anchor bolts, each fitted with two hex nuts and two flat washers, shall be furnished with each pole. The top 12 in. of each anchor bolt, nut and washer shall be galvanized in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Anchor bolt shall have diameter of 1.50 in., straight length of 54 in., and a 6 in. hook length.

Perforated Aluminum Skirt:
A perforated aluminum skirt in accordance with 910.19(b) and Standard drawings 807-LTHI-010 shall be provided.

Ground Rod and Connections:
Ground rod and connections shall be provided in accordance with 922.16 and Standard drawings 807-LTLR-01 &02, and E 807-LTFD-07.

3. Construction Requirements

Working drawings shall be submitted in accordance with 105.02 for folding poles. The working drawings shall include the pole height, number of sections, the pole shaft data for each section, camera assembly, handhole details, material required, and complete anchor bolt details including bolt circle projection and hardware.

The working drawings shall include the design calculations and data for approval prior to fabrication in accordance with 807.03.

4. Method of Measurement

Folding poles and foundations will be measured by the number of units installed.

Conduit and wire will be measured in accordance with 807.18. Cameras (pay item 805-06997) and CCTV assembly (pay item 809-06128) will be measured by the number of units installed.

5. Basis of Payment

Folding poles will be paid for at the contract unit price per each, complete in place.

ITS folding pole foundation, concrete, with grounding will be paid for at the contract unit price per each for the size specified. If class X material is encountered during lighting foundation excavation, payment will be made for such excavation in accordance with 206. Partial payment for ITS pole foundation in the amount of 80% will be made if all such work is complete except for finish grading and sodding. The remaining percentage of payment will be made upon completion of the finish grading and sodding.

Conduit, and wire will be paid for in accordance with 807.19. Cameras and CCTV assembly will be paid for at the contract unit price per each, complete in place.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Camera	EACH
CCTV Assembly	EACH
ITS Pole, Folding, __55___ ft (height)	EACH
ITS Pole Foundation, Concrete, with Grounding, ____in. x _____ in. x _____ in	EACH

The cost of the pole; power cable and support cable; anchor bolts and nuts; lightning rod assembly; grounding system; and all incidental materials necessary to complete the installation shall be included in the cost of the ITS folding pole. The cost of excavation, concrete, sleeves for cable-duct, non-metal pipe, reinforcing bars, backfill, finish grading, and sodding shall be included in the cost of ITS pole foundation.

ITS POLE STRUCTURE

Description

This work shall consist of the design and installation of ITS pole structure in accordance with 105.03.

Materials

Materials shall be in accordance with 807.02 and as follows:

The ITS pole structure material shall be in accordance with ASTM A595 or A 572, Gr 55. The base plate materials shall be in accordance with ASTM A36. Anchor bolt material for ITS pole structure shall be in accordance with ASTM F1554, Gr 55. Each anchor bolt shall be provided with 2- hex nuts and 2- washers with minimum 15 in. threaded end galvanized in accordance with ASTM A153. Structure shall be galvanized after fabrication in accordance with ASTM A123 or AASHTO M111.All connection hardware for the two upper sections shall be in accordance with ASTM A325. All other ITS pole shaft hardware, including hardware for the handhole door and the latch mechanism, shall be stainless steel in accordance with ASTM F593 or A594, type 304 or 305, except where otherwise specified.

The Camera Lowering Device Raise/lower cable terminator material shall be hot dip galvanized or stainless steel. All safety cable attachment hardware shall be as listed below:

- Turnbuckles, Crosby HG-225 Hook & Eye, 3/8”, Part # 1030672, or Approved Equal
- Round Pin Shackles, 5/16”, Crosby G-213 / S-213 or G-215 / S-215, Part #’s 1018035 or 1018838, respectively, or Approved Equal
- Clevis Link Chain, Crosby Grade 80 Alloy, 5/16”, WLL-4500lbs, Part # 273536 or Approved Equal
- A316 Stainless Steel Quick Links, Peerless, 3/8”, Part # H8224-0640 or Approved Equal
- Wire Rope Thimble, Crosby HDG, 5/16”, Part # 1037318 or Approved Equal
- Wire Rope, Stainless Steel, 5/16”, Type 305/316, Loos or Approved Equal
- Wire Rope Clamps to Secure Safety Cable to Pole Only, Crosby G-40, 5/16”, Part #1010079 or Approve Equal. Use swage connectors to connect wire rope to turnbuckle
- Pad Eyes for Welding to inside of pole for attaching/securing safety chains, Crosby S-264, Size #2, Part # 1090786 or Approved Equal,

Design and Fabrication

ITS poles shall be either the preapproved Valmont ITS pole, Millerbernd ITS pole, Ameron ITS pole or an approved equal designed and fabricated in accordance with the following criteria.

ITS approved equal pole shall be designed by a professional engineer. The Contractor shall submit 2 copies of signed and stamped plans and design calculations to the Engineer for approval. Working drawings for approved designs shall be in accordance with 105.02.

ITS pole structure supports shall be analyzed and designed in accordance with the 2013 edition of the AASHTO Standard Specifications for

Highway Signs, Luminaries, and Traffic Signals. The design recommendations in Article 2.6 of the AASHTO specification shall be followed.

ITS pole structures shall be design for 60 ft, 80 ft and 100 ft heights as follows.

1. Dead Loads:
    a. Self-Weight of ITS pole
    b. Camera and Camera lowering device – 95 lbs. each, total of 285 lbs. minimum.
    c. Equivalent Projected Area of 2.5 sq ft for each camera, total of 7.5 sq ft minimum.
    d. Lightning rod located at top of the pole top cover plate, located not to obstruct camera extension arm rotation.
2. Wind Loads:
    a. Basic speed – 90 mph
    b. Wind Importance Factor, Ir = 1
    c. Height and Exposure Factor, Kz = 1.265, for 60 ft, 80 ft & 100 ft height.
    d. Gust Effect Factor, G = 1.14
3. Ice Load:
    a. Included in accordance with article 3.7 of the AASHTO specifications for full wind analysis.
    b. Not included for deflection design criteria.
    c. Assume ice forms on one side only. Use 3 lbs /sq ft.
4. Fatigue:
    a. Applied to all components, mechanical fasteners and weld details of support structures in accordance with article 11.5 of the AASHTO specification.
    b. Fatigue Category, IF – I.
5. Deflection Design Criteria:
    a. 60 ft and 80 ft ITS poles shall be designed for 1 in. maximum pole top deflection at wind velocity of 30 mph with no gust.
    b. 100 ft ITS poles shall be designed for 3 in. maximum pole top deflection at wind velocity of 30 mph with no gust.

ITS pole structure supports shall be an anchor base type pole structure and shall include a handhole and a pole top cover plate. The ITS pole shall be either multisided, round or combination of multisided and round tubular members. Handhole shall be located at 45 in. for pole up to 80 ft heights and at 48 ft. for 100 ft pole height, outside dimensions of the handhole shall be 28 in X 9 in. Opening for the handholes shall be reinforced to maintain the design strength of the pole. The handhole shall have a weatherproof gasket made of neoprene or silicone rubber. The gasket shall be formed for a fit around the handhole or be attached by mechanical means. The door and hinge shall be the same type steel as poles. The hinge pins and other securing hardware shall be stainless steel and tamperproof. The door shall be fabricated to allow for a padlock, which is not included in the hardware. The hasp used for padlocking shall be fabricated from stainless steel. Provisions shall be made to bolt the door securely shut. The door shall include a bug proof aperture with a minimum opening of 4 sq in. Two bonding plates shall be furnished which are accessible through the pole handhole for connecting the ground wires. A connection shall be furnished for an additional ground wire on the outside of the pole near the base plate.

The upper camera mounting extension section shall be designed and fabricated per listed below details:

- This section shall be 40 in. long, measured from top of the top mounting flange plate to the bottom of bottom mounting flange plate.
- Design for one camera mounting with camera lowering device and shall have a lightning rod mounting.
- Bottom mounting plate shall have 12– 13/16 in. X 3 in. slotted holes centered radially at 30 degrees.
- Top mounting plate shall have 12 – 7/8 in. holes. Pole top cover plate shall have 12– 7/8 in. holes and provision for attaching 0.5 in. threaded lightning rod.
- One camera mounting plate shall be located at centered 30 in. up from the bottom of the bottom mounting flange plate.
- It shall have a handhole with cover, minimum inner diameter size of 4 in. X 6.5 in. located at 90 degrees from camera mounting plate and centered on camera mounting plate.
- Lightning rod can be mounted above camera arm and/or may be mounted on pole top cover plate.
- This section shall be provided with an integral wire support hook for all cables.

The lower camera mounting extension section shall be design for and fabricated per listed below details:

- This section shall be 40 in., measured from top of the top mounting flange plate to the bottom of bottom mounting flange plate.
- Design for mounting two cameras & camera lowering devices oriented at 180 degree apart positions.
- Bottom mounting plate shall have 12– 13/16 in. X 3 in. slotted holes centered radially at 30 degrees.
- Top mounting plate shall have 12 – 7/8 in. holes.
- Two camera mounting plates shall be located at centered 30 in. down from the top of the top mounting flange plate.
- Shall have a handhole with cover, minimum inner diameter size of 4 in. X 6.5 in. located at 90 degrees from camera mounting plates and centered on camera mounting plate.
- This section shall be provided with an integral wire support hook for all cables.

Pole sections which are slip fitted shall have slip joints with a minimum overlap of 1.5 times the diameter of the bottom of the upper section of the slip joint. ITS pole having slip joint construction shall be match marked at the factory and shall be shipped disassembled at the work site. Slip joint shall be marked to ensure that the 1.5 times diameter insertion is provided.

After fabrication, the pole shall be cleaned and galvanized. Galvanized steel pole, including the handhole, handhole door, base plate mounting plates, and all other elements welded to the shaft shall be hot dip galvanized in accordance with ASTM A123 or AASHTO M 111.

Base Plate

A one-piece base plate shall be secured to the base of the pole and shall develop full strength of the pole. The base plate material shall be in accordance with ASTM A36.The outside diameter shall be 37 in... The bolt circle shall have a 33 in. diameter. It shall have 10 anchor bolt holes of size 1.75 in. diameter X 54 in. X 6in. (hook).

Camera Lowering Device Raise/Lower Cable Terminator

The individual camera raise/lower cables will terminate approximately 4 in. to 6 in. below the top of the handhole frame and be secured by a safety chain or cable when the camera is secured at the top of the pole and being lowered. The camera raise/lowering cable will terminate in a loop utilizing a thimble to prevent cable abrasions and a quick link that the safety chain hook of a ½ in. x 6 in. hook and eye turnbuckle can hook to the quick link of the camera raise/lower cable quick link. The anchor end of the safety chain will be secured to a plate, an oval eye, or forged steel pad eye welded to the pole face opposite the handhole opening and the two adjacent faces. They will be placed near the bottom of the handhole opening. The safety chain overall length shall be field adjustable by use of a Hook & Eye Turnbuckle, Round Pin Shackles or Chain Quick Links, and Chain sized to fit Shackles and Quick Links.

Anchor Bolts

Ten anchor bolts, each fitted with two hex nuts and two flat washers, shall be furnished with each pole. The top 12 in. of each anchor bolt, nut and washer shall be galvanized in accordance with the coating thickness, adherence, and quality requirements of ASTM A 153, class C. Anchor bolt shall have diameter of 1.75 in., straight length of 54” , and a hook length if 6 in.

Perforated Aluminum Skirt

A perforated aluminum skirt in accordance with 922.16 and Standard Drawing 807-LTHI-010 shall be provided.

Ground Rod and Connections

Ground rod and connections shall be provided in accordance with 922.16 and Standard Drawings 807-LTLR-01 & 02, and E 807-LTFD-07.

Construction Requirements

All work shall be in accordance with 807.

Method of Measurement

ITS pole structure will be measured by the number of units installed.

Basis of Payment

ITS pole structure will be paid for at the contract unit price for each, complete and installed.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS Pole Structure, _____height.....	EACH

The cost of design, working drawings, fabrication, installation, and all incidentals shall be included in the cost of ITS pole structure.

FOUNDATION, ITS POLE STRUCTURE

Description
The work shall consist of the design and construction of foundations for ITS monopole structures in accordance with 105.03.

Materials
Materials shall be in accordance with the following:

Concrete, Class A.....702
Reinforcing Bars.....910.01

Reinforcing bars shall be epoxy coated.

Construction Requirements
The foundations for proposed ITS Pole Structures shall be designed to accommodate the loading as shown on the plans, and shall adhere to current AASHTO guidance. Specifically, the foundations shall be designed to accommodate both of the following design loads:

Design Loads at the base for pole heights up to 100’	
Axial Loads	5827.5 lbs
Bending Moment	163,281.8 ft-lbs
Torque	154.8 Ft-lbs
Shear	3157.1 lbs

Design Loads at the base for pole heights up to 100’	
Axial Loads	7934 lbs
Bending Moment	134,573 ft-lbs
Torque	517 Ft-lbs
Shear	2524 lbs

The foundation shall be designed by a professional engineer. The Contractor shall submit two copies of signed and stamped plans and design calculations to the Engineer for approval. Working drawings for approved designs shall be in accordance with 105.02.

Each foundation shall have a tooled line, imprinted arrow, or other type of permanent marking on the top of the foundation to indicate the direction of the conduits.

During excavation of the foundation, all material shall be removed to the full depth as shown on the foundation working drawings, except if class X material is encountered, the work shall be performed in accordance with 206.02(b).

If the sidewalls of the excavated areas remain firm and stable, concrete may be poured directly against the dirt below the level of the top 6 in. form. Otherwise, the concrete foundation shall be fully formed by means of a paper preformed liner or other approved means. However, the foundation shall be formed to the proper size for the top 6 in. before concrete is poured. If a paper liner is used, it may be withdrawn as the concrete is placed or it may be left in place permanently. If the liner is left in place, all voids between the excavation walls and the form shall be filled and compacted using coarse aggregate No. 53. If the liner is withdrawn, the top 12 in. of the foundation shall remain formed until the concrete has obtained initial set.

Method of measurement
Foundation, ITS pole structure will be measured by the number of units installed.

Basis of payment
Foundation, ITS pole structure will be paid for at the contract unit price per EACH.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Foundation, ITS Pole Structure	EACH

The cost of design, working drawings, excavation, installation, and all incidentals shall be included in the cost of foundation, ITS pole structure.

PADLOCKS

Description
This work shall consist of furnishing and installing padlocks for all cabinets, fence gates, and enclosures specified in these Special Provisions.

Materials
The padlock shall be classified as a high security padlock with hardened shackle, laminated body, 4 pin cylinder (minimum) and come complete with a weather cover to protect the lock body and cylinder from sand, dirt, water and ice. A wafer cylinder shall not be used.

NO keys shall be provided to the Department with each padlock supplied. All padlocks shall be keyed alike and be identical to the keys currently in use by the Department. The main body width of the padlock shall not exceed 3” and have a shackle length of 2.25” to 3.75” and a shackle diameter of 5/16”.

For padlock information, contact,

Brian Stoner,
ITS Technology Deployment Division Maintenance Supervisor
Indiana Department of Transportation
(317) 690-5534
bstoner1@indot.in.gov

Method of measurement
The Padlocks will be measured per item provided by the unit of EACH.

Basis of payment
The Padlocks will be paid for at the contract unit price of EACH.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS, Padlock	EACH

REMOTE POWER SWITCH

Description

The remote network power switch unit provides continuous auto-fault detection. When IP connectivity failure is detected, it will automatically reboot some or all of the connected devices. In addition it provides web based troubleshoot and monitoring capabilities. This device shall be furnished and installed in a cabinet, shelter, or DMS.

Materials

The Remote power switch shall conform to the minimum following specifications:

- Operating temperature: 30° F to 170° F
- Power Outlets: Min.(8) NEMA 5-15R
- Protocols Supported, Minimum: HTTPS, TCP/IP, UDP, SNMP, Telnet, SSH, BOOTP, DHCP
- Connections: RJ-45 10/100 Mbps Ethernet
- Surface mount
- Optional 19" Rack Brackets Included
- Power Control & Management: Remote individual or group outlet switching, Plug naming, grouping & access control, Scheduled outlet On/Off/Reboot switching, Ping watchdog with auto reboot

Construction Requirements

A remote power switch shall be furnished and installed at each location per the manufacturer specifications. The switch and AFP shall be connected to the device.

Method of measurement

The remote power switches will be measured for payment by the unit EACH complete and in place. This work shall include test and performance verification, and incidentals necessary to complete the work.

Basis of payment

Remote power switches will be paid for at the contract unit price of EACH

Payment will be made under:

Pay Item	**Pay Unit Symbol**
ITS, Remote Power Switch	EACH

The cost of materials, labor, equipment, transportation, placement and all incidentals shall be included in the cost of the pay item.

SURGE PROTECTION DEVICES FOR ATMS COMMUNICATIONS, VIDEO, AND 24V

Description

This Section includes Surge Protection Devices (SPDs) for data, communications, 24V power, and video equipment. Surge Protective Devices shall be used for the protection of all data, communications, video circuits, and low voltage power at 24V or less including POE cables from the effects of lightning induced currents and other transients.

Materials

Data and Communications Cables:

Plug-in jack or terminal connected SPDs shall protect all low-voltage signal pairs. The SPDs shall meet or exceed the following minimum requirements:

1. The SPDs shall be UL Listed 497B.
2. The protectors shall suppress a peak surge current of up to 10K amps.
3. The protectors shall have a response time less than 5 nanoseconds.
4. The protector shall clamp the voltage between the two wires at 8 volts and clamp the voltage between each wire and ground at 50 volts.
5. The first stage of protection shall be a three-element gas discharge tube, and the second stage shall consist of silicon clamping devices.
6. It shall be possible to replace the protector using standard tools.
7. The SPD housing shall be metallic and be grounded.

Coaxial Video Cables:

Cables carrying video signals shall be equipped with surge protectors that shall meet or exceed the following minimum characteristics:

1. The clamping voltage shall be 11 volts between the shield and center conductor signal line.
2. The response time shall be five nanoseconds or less.
3. Bipolar silicon avalanche diode technology shall be used in a single stage device.
4. The module shall dissipate a minimum of 50 Joules.
5. The module shall have BNC connectors.
6. The housing shall be metallic and grounded.
7. The module shall pass signals from DC to 80 MHz with less than 0.5 dB insertion loss.

24V Power Cables:

Cables carrying 24V power shall be equipped with surge protectors that shall meet or exceed the following minimum characteristics:

1. The clamping voltage shall be 50V.
2. The response time shall be five nanoseconds or less.
3. Bipolar silicon avalanche diode technology shall be used in a single stage device.
4. The module shall dissipate a minimum of 50 Joules.
5. The module shall pass signals from DC to 80 MHz with less than 0.5 dB insertion loss.

Construction Requirements

Examine conditions for compliance with requirements for installation tolerances, characteristics, and other conditions affecting performance of transient voltage surge suppressors. Do not proceed with installation until unsatisfactory conditions have been corrected.

Conductors between the SPD and the point of attachment shall be kept as straight and short as possible.

The SPDs ground shall be bonded to the cabinet’s grounding bar. Ground each SPD’s enclosure.

Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

Install an appropriate SPD at all data, communication, video, and low voltage connections or termination.

Method of Measurement

Transient voltage surge suppressors for data, communications, 24V and video will not be measured for payment.

Basis of Payment

Transient Voltage Surge Suppressors for data, communications, 24V and video will not be paid for separately, and will be considered incidental to the cost of equipment being provided on this contract.

VAULT, ATMS

Description
This work consists of furnishing and installing ATMS vaults for communications cable access as shown on the plans.

Materials
Materials for the ATMS vault shall be as shown in the plans and in accordance with 807.03. All vault covers are required to be bolted into place to prevent accidental removal by mowing crews or other unintentional means. The cover frame shall be installed in the vault with a butyl rubber sealant in tape/coil form for a proper seal and to prevent the frame from moving out of place. The sealant shall comply with ASTM C990 for butyl rubber sealants. The vault rings and covers shall be as shown on the plans and in accordance with 807.09 except the message displayed on the lid shall read "TRAFFIC MANAGEMENT SYSTEM". Fabrication of these vault covers shall not commence until working drawings that the Contractor shall have submitted have been approved by the Engineer.

Construction Requirements
ATMS vaults shall be installed at all planned and potential future fiber optic cable splicing locations and at additional locations as shown on the plans.
Material surrounding the buried conduit splices and ATMS vaults shall be tamped and added in such a manner so that there are no voids or depressions formed. Conduit entrance and exit points in the new ATMS vaults shall be sealed watertight.
ATMS vaults shall be precast. The top of the vault shall be flat and level with the surrounding ground. The vault shall be placed such that final grading will provide a minimum of 4 inches of soil over the concrete box. Clean applicable surfaces before installing butyl sealant on the cover frame prior to installation in the vault. Adhesive primer shall be used when moisture is present on surfaces. Follow manufacturer's instructions for proper installation. When the installation is completed, all disturbed portions of the construction area shall be cleaned, and any excess excavation or other materials shall be properly disposed of as soon as possible.

Method of Measurement
The completed work as described for ATMS vault will be measured by the unit of each and shall include furnishing and installation of a new vault, a bolt down cover, butyl sealant, excavation, and all other accessories, grading, and re-seeding necessary for a complete installation.

Basis of Payment
Payment for the work included in this special provision will be paid for at the Contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Vault, ATMS	EACH

The cost of materials, labor, equipment, transportation, placement, and all incidentals shall be included in the cost of the pay item.

All earthwork preparation and grading necessary for installation of the vault shall be considered incidental to this work. All final clean-up and disposal of excess excavation shall be considered incidental to this work.

WIRELESS VEHICLE DETECTION SYSTEM

Description

This work shall consist of furnishing and installing wireless vehicle detection systems for vehicle detection at traffic signals.

Materials

The wireless vehicle detection system, WVDS, is comprised of wireless magnetometer detectors, contact closure cards, receiver processors, and wireless repeaters installed for a signalized intersection. The system shall be capable of monitoring vehicles on a roadway via detection of changes in inductance caused by the presence or passage of a vehicle and shall provide detector outputs to a traffic signal controller.

The WVDS shall include magnetometer detectors, a minimum of two receiver processors, the required mounting equipment, cables, rack mounted cards, set-up and operating software, all connectors, and miscellaneous equipment necessary for the installation and operation of the system. If required, the WVDS shall also include wireless repeaters.

Only models from the Department's approved materials list for traffic signal control equipment shall be used.

Ethernet cable for wireless vehicle detectors shall be outdoor rated and UV shielded.

Construction Requirements

Prior to the installation, the Contractor shall test all wireless magnetometer detectors and demonstrate proper operation and communication between the wireless magnetometer detectors and the receiver processor and wireless repeater, if required.

Prior to the installation, the Contractor shall demonstrate that each wireless magnetometer detector is within range of its corresponding receiver processor, using wireless repeaters as necessary. All wireless magnetometer detectors assigned to either a receiver processor or wireless repeater shall be located within a 120° arc measured from the receiver processor or wireless repeater.

The Contractor shall install each wireless magnetometer detector in the roadway according to the manufacturer's recommendations with one wireless magnetometer detector programmed to count vehicles for each through travel lane. Holes cored in the pavement shall be cleaned and dried before installing wireless magnetometer detectors. The cored pavement shall be backfilled according to the manufacturer's recommendations.

Receiver processors and wireless repeaters shall be mounted on traffic signal steel strain, pedestal, cantilever poles, or square steel sign posts. If a square steel sign post is used, it shall have a length of no more than 24 ft and a Type 3 object marker shall be installed on the post, with a mounting height of 4 ft, measured from the edge of the traveled way to the bottom of the object marker. The mounting height of receiver processors above the pavement surface shall be between 20 ft and 35 ft. The mounting height of wireless repeaters above the pavement surface shall be between 13 ft and 35 ft.

The minimum distance between a receiver processor and wireless repeater

mounted on the same structure shall be 2 ft. This distance may be increased to enable better communication between the devices.

After installation, the Contractor shall demonstrate successful communication between each wireless magnetometer detector, receiver processor, and wireless repeater to the Engineer.

Method of Measurement

Wireless magnetometer detectors contact closure cards, receiver processors and wireless repeaters will be measured by the number of units installed.

Basis of Payment

Wireless magnetometer detectors contact closure cards, receiver processors and wireless repeaters will be paid for at the contract unit price per each.

Pay Item	Pay Unit Symbol
Contact Closure Card	EACH
Receiver Processor	EACH
Wireless Magnetometer Detector	EACH
Wireless Repeater	EACH

The cost of coring the pavement, sealant, and all work necessary for proper installation and operation of the wireless magnetometer detectors shall be included in the cost of the wireless magnetometer detector.

The cost of cables, connectors, set-up and operating software, access boxes, rack mounted expansion cards, and all hardware necessary to complete the installation shall be included in the cost of the contact closure cards.

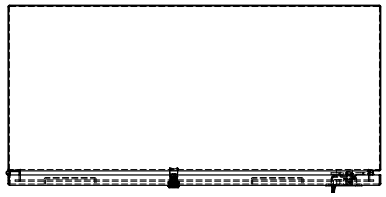
The cost of required mounting equipment, cables, connectors, and miscellaneous equipment necessary for proper installation and operation of the receiver processors shall be included in the cost of the receiver processors.

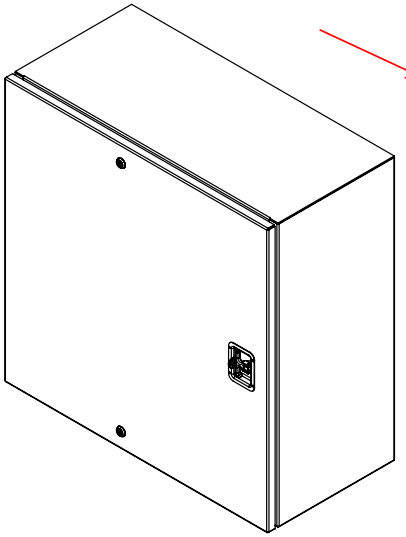
The cost of required mounting equipment, connectors, and miscellaneous equipment necessary for proper installation and operation of the wireless repeaters shall be included in the cost of the wireless repeaters.

Attachment 17-2
USP On-Bridge Junction Box

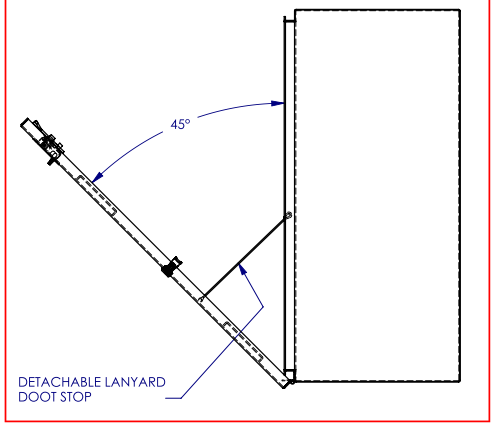
STOCK CODE	"X"	"Y"	"Z"	MATERIAL	THICKNESS
EP-363616-LT-AL	36	36	16	ALUMINUM	.125

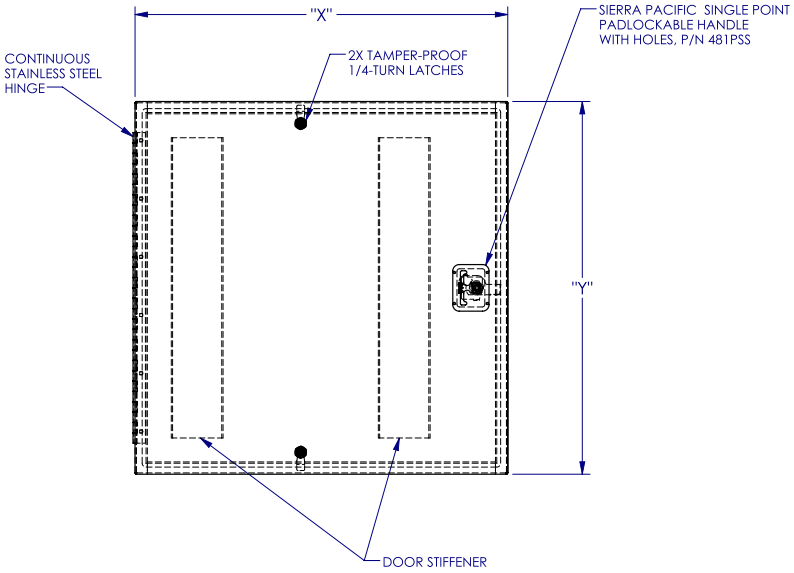
Dimensions shown for reference only

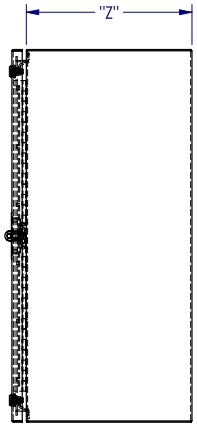




REVISION HISTORY			
REV.	DESCRIPTION	DATE	APPROVED
00	INITIAL DESIGN	03/23/2015	MNG







NOTES:

1. PROUDLY MADE IN AMERICA AT SOUTHERN MANUFACTURING ISO 9001:2008 REGISTERED FACILITY.
2. CABINET IS CONSTRUCTED FROM .125" THICK 5052 ALUMINUM AND FULLY WELDED TO NEMA 4X STANDARDS.
3. CABINET HAS DOUBLE FLANGED DOOR OPENING, SINGLE DOOR WITH STIFFENERS.
4. DOOR HAS SINGLE POINT FOLDING "T", PAD LOCKABLE HANDLE, CONTINUOUS STAINLESS STEEL HINGE,NEOPRENE GASKET ALL AROUND, AND TAMPER-PROOF 1/4-TURN LATCHES (2X).
5. ALL HARDWARE IS STAINLESS STEEL.
6. PROCEDURES, WELDERS, AND WELDING OPERATORS CONFORM TO AWS REQUIREMENTS A S CONTAINED IN AWS B3.0 AND C5.6 FOR ALUMINUM. ALL EXTERIOR SEAMS ARE CONTINUOUSLY WELDED AND ARE SMOOTH. ALL EXTERIOR WELDS ARE MADE BY THE TIG WELDING PROCESS. ALL INTERIOR AND EXTERIOR EDGES ARE FREE FROM BURRS

SOUTHERN MANUFACTURING

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES
TOLERANCES
X = ± .05
.XX = ± .03
.XXX = ± .01
ANGLES = ± 1.0
THIRD ANGLE PROJECTION
PROPRIETARY AND CONFIDENTIAL

APPROVALS
DRWN MNG 5/4/2015
APRV SP 5/4/2015
FINISH
NONE
MATERIAL
.125"
5052-H32 ALUM

CONFIDENTIAL PROPRIETARY INFORMATION OF:
Southern Manufacturing
LONGWOOD, FLORIDA, USA 32750
LOCATION: S:\CAD\1SOLIDWORKS\LIFT UP BOX\Assemblies\
FILE NAME: EP-XXYYZZ-LTXX-SUBMITTAL
DESCRIPTION: LIFT TOP BOX
WEIGHT 26.1 LBS | DENSITY 0.0 | SURF. AREA 11635.1
CC | Part ID/CONFIGURATION -001 | REV 00
SCALE 1:12 | SIZE B | SHEET 1 OF 1